the OIL AND GAS JOURNAL

JUNE 3, 1957

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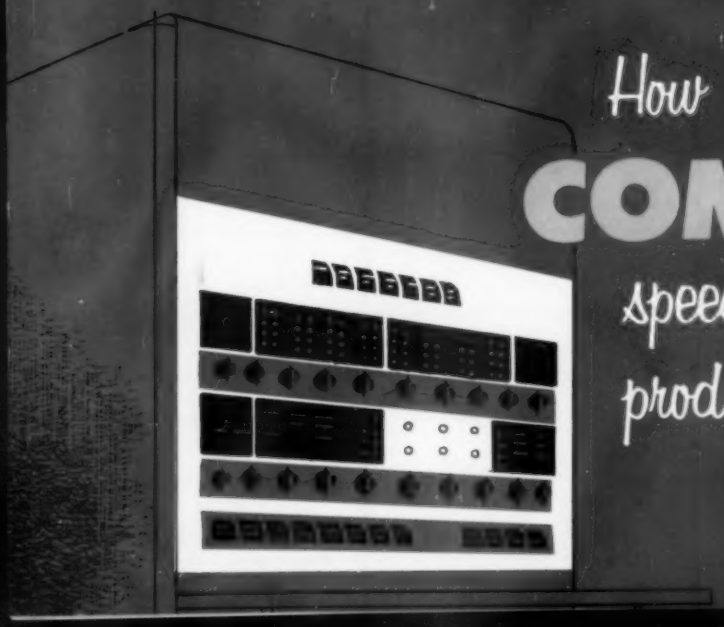

How COMPUTERS speed solutions to production problems

p. 110

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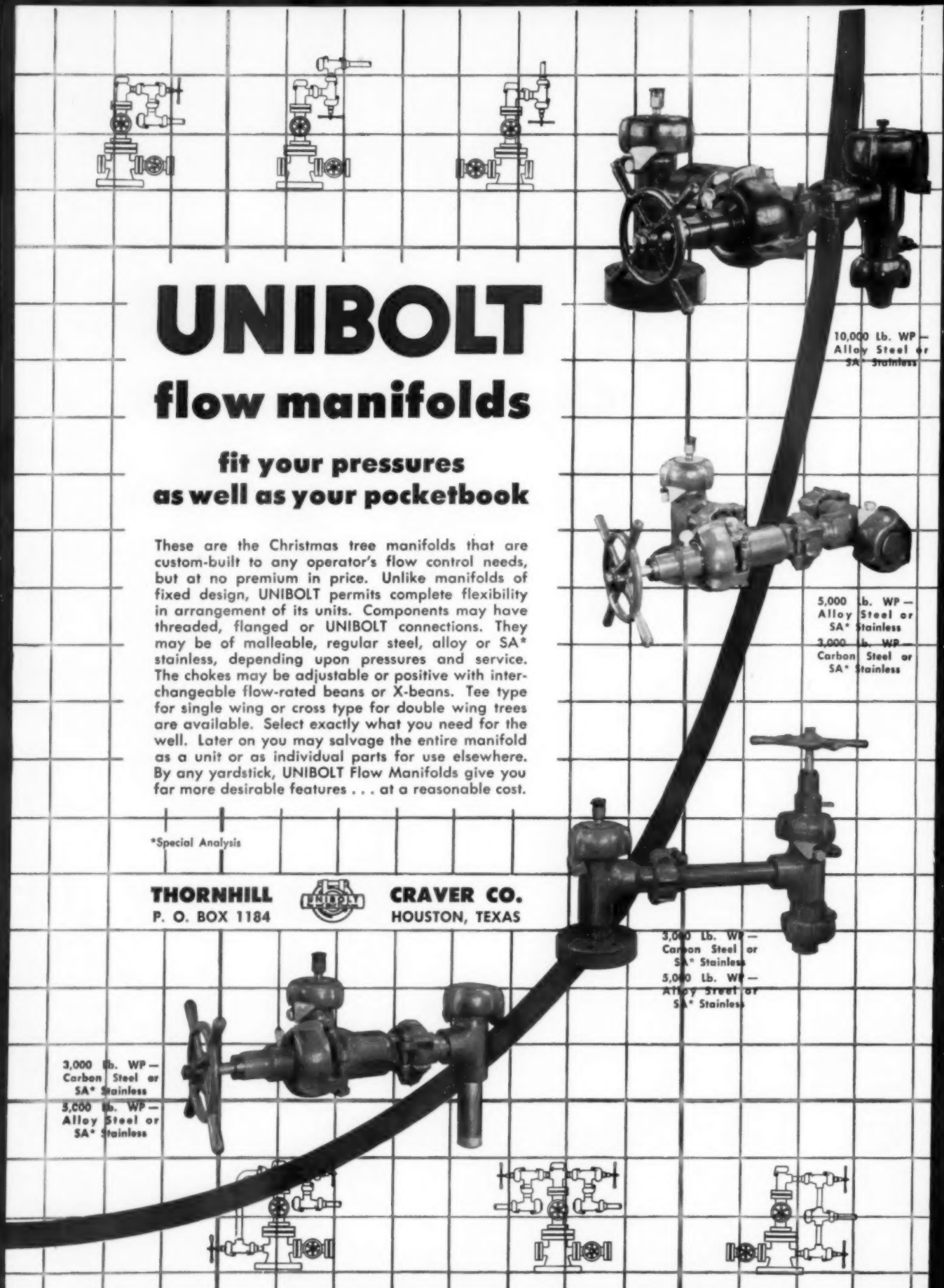
10,000 Lb. WP — Alloy Steel or SA* Stainless
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JOURNAL News Letter

June 3, 1957
Tulsa, Oklahoma

A shiny new refinery will invade the Narragansett Bay resort area:

Commerce Oil Refining has nailed down financing from Lehman Brothers and a custom-refining deal with Gulf. This appears to assure the long-talked $64 million, 43,000-bbl. refinery for Rhode Island. Also most of the objections raised by naval and society leaders have been overcome (P. 61).

Location will be on a large tract on Conanicut Island in the bay north of Jamestown. Latest processing schemes will be installed by Lummus. Products will be 100-plus octane pool gasoline, fuel oils, L.P.G., coke, and sulphur. Charge stock will be a 31°-gravity sour crude similar to West Texas or Kuwait. The development climaxes an interesting 2-year battle to get a refinery for the northeast region.

INDUSTRY: Oil's sick public relations needs two stimulants: A bold information spokesman in Washington and the help of everyone in the industry working for a better understanding for oil with their home-town friends. These observations were made by Publisher P. C. Lauinger of The Oil and Gas Journal to the annual gathering in Denver of Rocky Mountain Oil and Gas Association.

Biggest single danger facing the industry: What the Government might do through unwise oil legislation. This threat stems from ideas about the industry held by the people back home. And therein lies the greatest field for individual public-relations work.

EXPLORATION: Galveston bay is fast becoming a hot spot in the Gulf Coast offshore drilling play. Sun Oil has opened a new field 3-1/2 miles off the Chambers County shore in the upper portion of the bay. It's the sixth new-field discovery in the bay since the present exploratory spurt started late last year. Fourteen rigs are active in the fast-spreading development.

Tidewater is making interesting news in the Permian basin. It is giving substance to arguments of many operators that the basin is good for many more years of exploratory and development drilling. Tidewater's 6 Coates 4 miles east of Jal, N.M., in an old shallow field came up with three possible pay formations. It had heavy oil flow from the Ellenburger and recoveries from the McKee and Tubb zones.

Pan American Petroleum again is proving the value of hunting oil around salt domes. Its 1 Hudson has brought in the first salt-dome field on Minden dome, Webster Parish, in Northern Louisiana. Sixteen other dry salt domes may lure oil explorers into Northern Louisiana now (P. 167).

The 1 Yakutat wildcat in Alaska's Icy Bay area has been temporarily abandoned by Colorado Oil & Gas. The rig will move 3 miles northeast of the abandoned well to begin a second test on its large block of acreage. The 1 Yakutat went to 9,314 ft. and still was in Tertiary sediments. Fish was lost in the hole after the 9,314-ft. depth. No tests were run. The second well is scheduled for 10,000 ft.

The American combine which has moved into Honduras hopes to spud a wildcat by July on its 11,000,000-acre concession. Aerial photography and surface work are starting immediately. The concession covers most of Santa Barbara and Olancho provinces.

Russian press is excited about new oil discoveries near Bukhara and Kagan in the Uzbek republic. Reports say reserves of Middle East proportions have been uncovered. Funds are being requested for immediate development.

DRILLING: Experiences of Imperial in western Canada are shedding new light on effect of water on air drilling. Air drillers handled inflowing water by blowing it out of the hole at rates up to 500 bbl. an hour. They used foaming agents and air pressure of 900 psi. However, Imperial confirmed that heavy water inflow cuts penetration rates of air drilling drastically. At influx of 100 bbl. hourly, air drilling was no more economical than mud drilling. At 500 bbl. an hour, the penetration rate was no greater than the mud.

Operators in North Dakota are heaving a sigh of relief. The threat to the accepted 80-acre spacing pattern has been averted. The state Industrial Commission extended regular spacing rules to new areas surrounding Calvert Drilling Co.'s Tande discovery north of Tioga field. The commission also prevented Warren Petroleum from drilling a south offset to its 1 Setterlund which was an offset to the Tande discovery. Warren's 1 Setterlund was off pattern, and approval for the second well would have opened the door to 40-acre spacing in the state. Many operators opposed that move as an unwarranted boost to their development costs.

Numerous changes in equipment and techniques for stratigraphic drilling from floating barges off the California coast have gone almost unnoticed. These drilling barges have explored up to 6,000-ft. depths. Recent additions to their equipment include electric-logging units, power-driven reels for handling mud-return and hydraulic lines, and closed-circuit television for viewing the ocean-bottom wellhead equipment (P. 86).

One of the real powerful rigs in West Texas today is a portable job capable of drilling to 20,000 ft. It is designed so that engines, draw works, and chain compound make only four truck loads. Pin-and-eye connections make it possible to tear down, move 50 miles, and rig up for drilling in 3 to 4 days (P. 98).

PRODUCTION: Biggest propane-injection project so far attempted is being planned by Magnolia in Big Parks field of Midland County, Tex. Magnolia proposes to use a miscible-phase flood on 8,160 acres of the field.

Target will be the bend section of the Pennsylvanian. Magnolia has been testing a pilot water flood of the same formation but will abandon it in favor of the propane. One unusual feature of the project: A distribution pipeline will be laid to move propane to the injection wells. The liquid gas will come from Pegasus field and the Driver area of Spraberry Trend area.

Here's the capital-cost data Shell has assembled from its experience in automatic custody transfer on the H. Henderson lease in Antelope field of Clay County, Texas: Investment of $10,000 is enough to install the L.A.C.T. and allow salvage of about $13,000 of conventional equipment. When installing a new battery on a lease, the L.A.C.T. system is $9,000 cheaper than an ordinary battery. Shell only began to pump oil automatically from Antelope field to pipeline but has run field tests on the idea for 9 years (P. 90).

The magic talents of electronic computers are speeding up improved production techniques. Carter Oil researchers find that among the problems the machines solve are: How to predict influx of water into a reservoir and the oil-gas phase behavior, how to analyze seismic reflection-time data, how much oil will be displaced by water or gas, and how to improve the odds of finding oil (P. 110).

The free world's crude production hit an all-time high in March of 15,271,900 bbl. daily--the second record in a row made while Suez still was shut down. The statistics just available shows the gains are attributed to a record 7,717,000-bbl. daily production in the U.S. and a new high of 2,923,610 bbl. daily in Venezuela.

Low gravity, highly viscous crudes can be handled by automatic custody transfer systems. Union Oil is demonstrating this in Yorba Linda field near Los Angeles. Its new installation in California has two unusual features: Meter proving on a gravimetric basis rather than by volume and hot-water heaters to keep the thick crude fluid during transfer.

REFINERS: Mark down hexamethylethane. This gasoline-blending material with a research-octane rating of 130 has just been made by Gulf researchers. They irradiated refinery gases in the nuclear laboratory to get the iso-octane blend. It's still a curiosity. It was made in small quantities at high cost. But its very synthesis from refinery byproduct streams point to future routes refiners may follow to get elevated octanes required by high-compression cars of the future.

Two more isomerization units are on the planning boards. Commerce Oil Refining will incorporate a 2,500-bbl. pentane isomerization unit at its Rhode Island plant. A major refiner plans a pentane unit soon, probably on the Gulf Coast, where it has light hydrocarbons available for upgrading to gasoline-blending stocks.

Refinery-construction costs are still edging upward. Nelson index shows a .2 point gain in latest month, standing at 201.7 compared to the 1946 index of 100. Slight gains in miscellaneous equipment and labor cost items accounted for the rise (P. 117).

Like to pay 92.1 cents for a gallon of premium gasoline? That's the going rate for Italian motorists. They pay the highest rate in the world. Premium-gasoline prices in other countries range from 53 to 91 cents a gallon. For this

interesting world survey on gasoline see page 66.

The battle between beefed-up premiums and third-grade superpremiums is getting hotter. The stepped-up premiums with 100-octane ratings or better are beginning to push the third grades in many areas, particularly along the East Coast. An example: Tidewater last week pulled the cork on its promotion for new beefed-up premium and regular. The premium rates better than 100, the regular 93.

Octanes now are beginning to jump on the West Coast, which has legged the rest of the country for nearly a year. Since the first of this year quality ratings on premiums have spurted up 0.9 R.O.N. The rating only advanced 0.8 for the entire previous 12 months. Meanwhile, the Ethyl octane survey shows ratings still rising during May over the U.S. Weighted average for premium was 98, a new record, while regular moved up to 90.8.

PIPELINING: Natural-gas producers in Laverne field of Northwestern Oklahoma are getting a record price for a large block of reserves. Michigan Wisconsin Pipe Line has completed a contract calling for 17 cents per M.c.f. which is 2 to 7 cents above most other contracts in the area. The price will escalate 2-1/2 cents every 5 years. Contract covers 70 per cent of field.

Permian Basin Pipeline has made an unusual arrangement with El Paso Natural. Permian is selling up to 200,000 M.c.f. daily of its production in Lea County, N.M., to El Paso. The reason is this: Permian has an oversupply until it gets FPC permission to expand its system. El Paso has an undersupply from the area. The deal helps both companies as well as producers in the region.

An FPC pricing decision threatens to delay first large-scale shipment of offshore gas in interstate commerce. Officials of C.A.T.C. group say decision has not been reached yet whether to go through with gas sale to Tennessee Gas Transmission following FPC price ruling.

The human side of automation is receiving as much attention as its economic and technical aspects. Given the choice of laying off employes or delaying plans for moving further into automatic operations, some pipeline companies are taking the latter course. They prefer to hold off until displaced workers can be absorbed elsewhere in the company.

Look for the pressure to mount for a pipeline to bring imported crude to inland refiners when Laurel products line is built next year from Philadelphia to Cleveland. Refiners in Ohio believe it's just a matter of time until competition will force them to process some foreign crude. Talk now indicates Middle East crude may be flowing as far west as Toledo in 5 years.

CRUDE PRICES: Persian Gulf crude prices moved upward 13 cents a barrel last week, the first increase in nearly 4 years. BP Trading, Ltd., made the higher posting for all crude lifted around the gulf. The big question now is: Will other buyers also raise? Industry sources in this country think the higher prices will stick. If so, it will firm up recent U.S. and Venezuelan price increases. They would have been undermined if Middle East crude remained low. The BP Trading action provided long-awaited good news to Western oil men.

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2½ years, 200,000 feet with one set of B. F. Goodrich V belts

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The OIL AND GAS JOURNAL

JUNE 3, 1957 • VOLUME 55 • NUMBER 22

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TECHNOLOGY—OPERATION

Pipelining

How Shell's Antelope L.A.C.T. System Works **90**

Automation in El Paso Natural's Compressor Plants **115**

By E. A. Walsh

Automatic operation, the first of three requisites for complete automation, has been accomplished at El Paso Natural's 10 gas-turbine-driven centrifugal stations.

Pipeline Patrol—Dry Ice as Welding Plug **131**

By J. D. Lewis

Dry ice can be used successfully in making oil-line repairs. It does not form a true weld plug because it constantly diminishes in size, but it acts as a fluid dam and vapor diluent in the line.

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By Larry Resen

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Cat Cracking with Kaolin Catalyst **95**

By D. Beyler, J. D. Maerker, and J. W. Schall

This catalyst is said to have four advantages over bentonite clay, two advantages over synthetic catalyst, and three advantages over both bentonite and synthetic.

Ripple Trays Help Boost Crude Throughput 50 Per Cent **103**

By T. J. Harvey and A. J. Connell

These versatile fractionation trays were installed in five columns at Canadian Oil Co.'s Sarnia refinery. This allowed a 58 per cent increase in crude capacity at a cost of about one-third that of installing new capacity.

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New Core-Hole Barge Boasts Many Improvements **86**

By D. H. Stormont

New Richfield barge has drilled to 6,000 ft. and could go deeper. Television camera keeps watch on operation of ocean-floor equipment.

How Shell's Antelope L.A.C.T. System Works **90**

By Ed McGhee

It helps conserve the gravity of the crude, and there's a capital-cost saving. The system is about $9,000 cheaper than an ordinary battery.

New West Texas Rig Is Powerful, Portable **98**

By Ed McGhee

Three engines can put 1,800 hp. on the draw works or on the mud pumps for drilling to 20,000 ft. Yet it can be torn down, moved, and rigged up easily and swiftly.

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By Dr. R. G. Hamilton and Paul Charrin

The concluding installment in this series on interpretation of electric logging.

Stopping Ventura Field Landslides **109**

By D. H. Stormont

Electronic Computer Helps Solve Production Problems **110**

By Dr. W. A. Bruce

Among them are: Predicting influx of water into a reservoir; determining oil displacement by water or gas; predicting oil-gas phase behavior; analyzing seismic reflection-time data; and improving the odds of oil finding.

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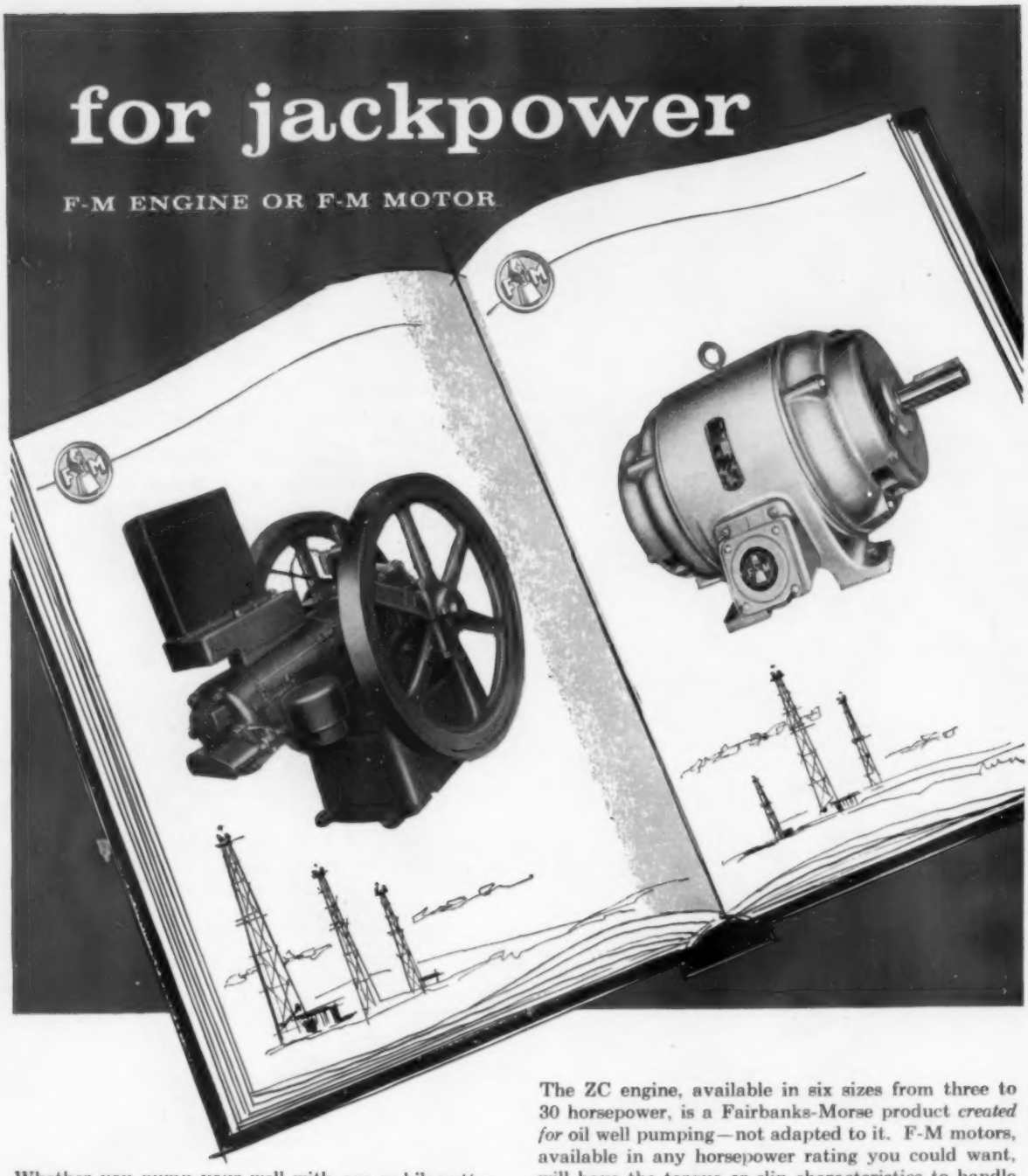

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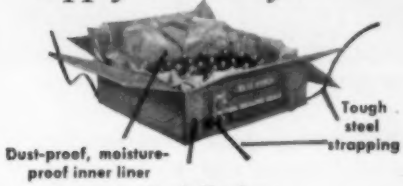

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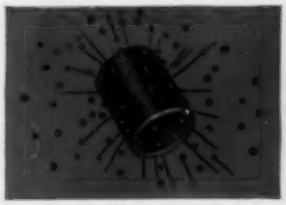

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NEW, big 9" clutch for smooth operation, longer life.

NEW longer track for greater stability, and increased traction.

NEW ease and convenience for the operator, comfortable box type seat. Operator does more with less fatigue.

NEW low silhouette assures maximum visibility.

Best of all, the OC-4 costs far less than most specialized machines of limited ability. Look around your present jobs and see how many it can handle for you. It makes your equipment dollars do double duty.

Oliver now offers several different models with 21.8 drawbar h.p. to fit your needs with a full line of attachments, including loader, Jet-Trencher, dozer, angle-blade, Universal trencher, winch, etc.

Ask also about the "Little Boomer" for light pipe laying jobs. Its 2000-lb. lifting capacity is enough to carry 40′ length of pipe up to 12" diameter. It frees your larger equipment for heavier work. Available with backfill blade and pipe bending shoes.

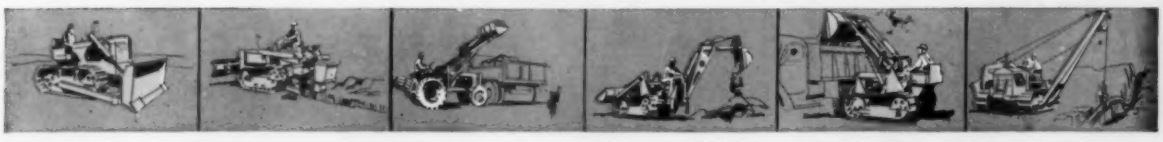
See your Oliver distributor today. Or write us.

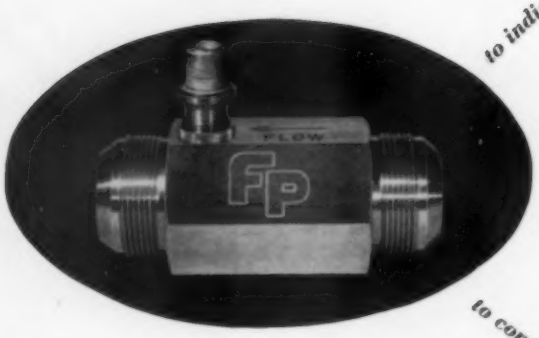
OLIVER

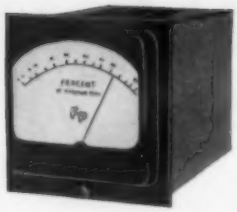
THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

a complete line of industrial wheel and crawler tractors and matched allied equipment.







PANEL FLOW RATE INDICATOR

to indicate flow

to indicate steady state flow condition

IN-LINE DIGITAL INDICATOR

to totalize flow for batch processes

DIGITAL TOTALIZER

to convert transient flow for analog output

FREQUENCY MULTIPLIER-CONVERTER

get flow information in any form you need it

. . . with F&P turbine meters and readout devices

Here's the ideal solution to flow metering problems characterized by high temperature, high pressure, high flow volume, or rapid flow transients. Fischer & Porter turbine meters are inherently among the most accurate flow measuring devices available today . . . providing measurements accurate to ½% of instantaneous rates.

The low inertia, axially balanced rotor of the F&P turbine meter gives optimum response to rapidly changing flow rates . . . providing positive information on changes as soon as they *begin*, not after they happen. A basic frequency output, directly proportional to flow, provides a common language easily fed to indicating, recording, or transmitting equipment. You can have digital or analog indication . . . oscilloscope recording . . . circular or strip chart recording . . . digital totalizing . . . transmission or any combination of these. Here are just a few of the Fischer & Porter output devices you can dovetail with one or more turbine meters:

PANEL FLOW RATE INDICATOR: Provides scale reading in desired flow units or in percentage of maximum flow. Includes amplifier which may be used to feed EPUT meters or integrators, and analog converter.

"IN-LINE" DIGITAL INDICATOR: Direct digital readout of flow information in desired gravimetric or volumetric units. Automatically selects turbine meter outputs by flow range.

DIGITAL TOTALIZER: Provides integrated flow information accurate to ½%.

FREQUENCY MULTIPLIER-CONVERTER: Extremely rapid response to transient flow signals. Sampling of eight points per cycle provides more information than conventional means.

For complete data on the F&P turbine meter and some of the systems it makes possible, write for catalog. Address request to Fischer & Porter Co., 3167 County Line Road, Hatboro, Penna.

FISCHER & PORTER CO.

Complete Process Instrumentation

Here's Refrigeration Designed For Every Basic Oilfield Application!

...It's The New BS&B "COLD-FRAC*" Ammonia Absorption Refrigeration Unit

OUTSTANDING FEATURES:

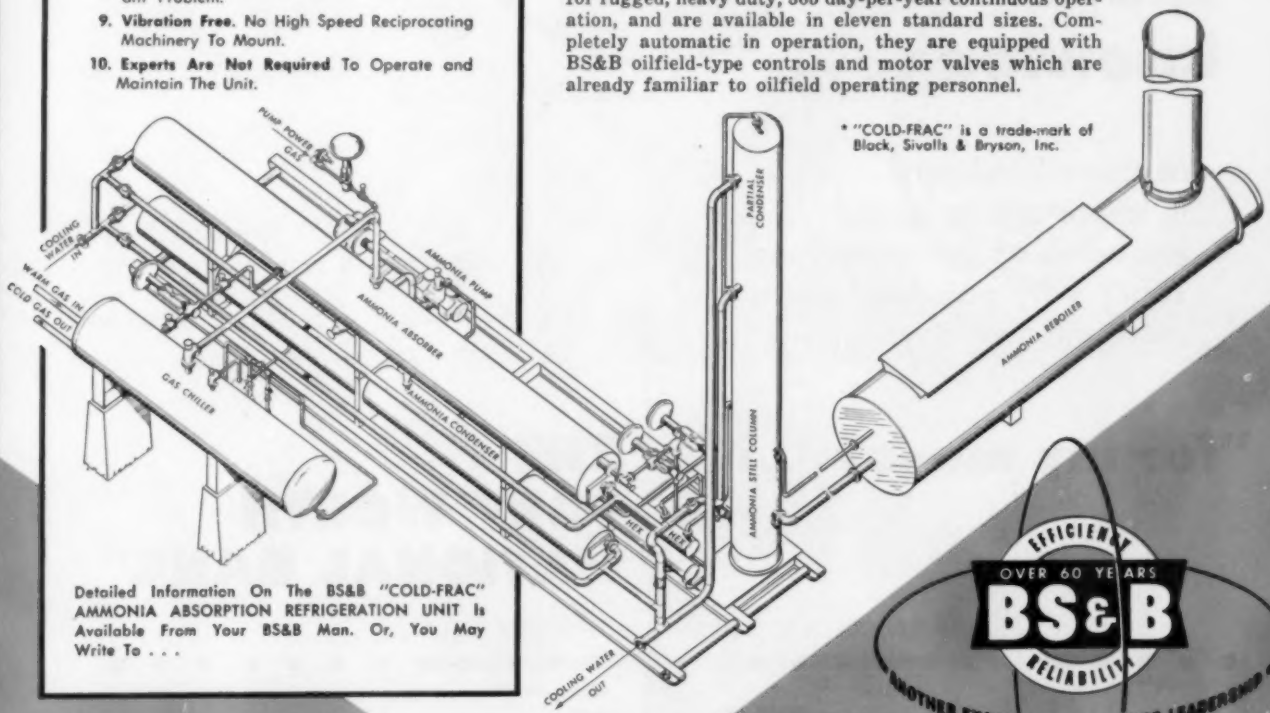
1. **Entirely Self-Operating.** Automatically Adjusts to Load Changes.
2. **Low Initial Cost.** Unit May Be Skid-Mounted Except Ammonia Reboiler. Outside Construction — No Buildings Required.
3. **Low Cost Maintenance.** Liquid Pump Is The Only Moving Part.
4. **Operating Costs Vary.** In Direct Proportion To The Load.
5. **Lower Operating Temperatures** Do Not Materially Decrease Capacity.
6. **Completely Closed System.**
7. **Chiller "Slop Over" Of Liquid Refrigerant Causes No Problem.** (There is no compressor to cause worry about liquids in the suction.)
8. **Oil Lubrication Eliminated.** No Oil-Refrigerant Problem.
9. **Vibration Free.** No High Speed Reciprocating Machinery To Mount.
10. **Experts Are Not Required** To Operate and Maintain The Unit.

With the development of BS&B's new "COLD-FRAC" AMMONIA ABSORPTION REFRIGERATION Unit, the oil industry now has a simple, non-mechanical, heavy duty artificial refrigeration system which is applicable to any oilfield or refining process requiring temperatures below ordinary atmospheric level.

A few examples of immediate industry applications are:

1. **Gas Pipeline Companies — For The Elimination Of Liquids In Gas Transmission Lines Through Better Hydrocarbon Dewpoint Control.**
2. **Gasoline Plants — For The Chilling Of Absorption Oil To Increase Hydrocarbon Recoveries Without Installing Larger Absorption Oil Towers Or Pumps.**
3. **Lease Production — To Provide Essential Refrigeration For Maximum Hydrocarbon Recovery Where Sufficient Pressure Expansion Is Not Available. Also To Supplement Declining "Natural" Refrigeration.**

These Ammonia Absorption Refrigeration Units are built for rugged, heavy duty, 365 day-per-year continuous operation, and are available in eleven standard sizes. Completely automatic in operation, they are equipped with BS&B oilfield-type controls and motor valves which are already familiar to oilfield operating personnel.



* "COLD-FRAC" is a trade-mark of Black, Sivalls & Bryson, Inc.

Detailed Information On The BS&B "COLD-FRAC" AMMONIA ABSORPTION REFRIGERATION UNIT Is Available From Your BS&B Man. Or, You May Write To . . .

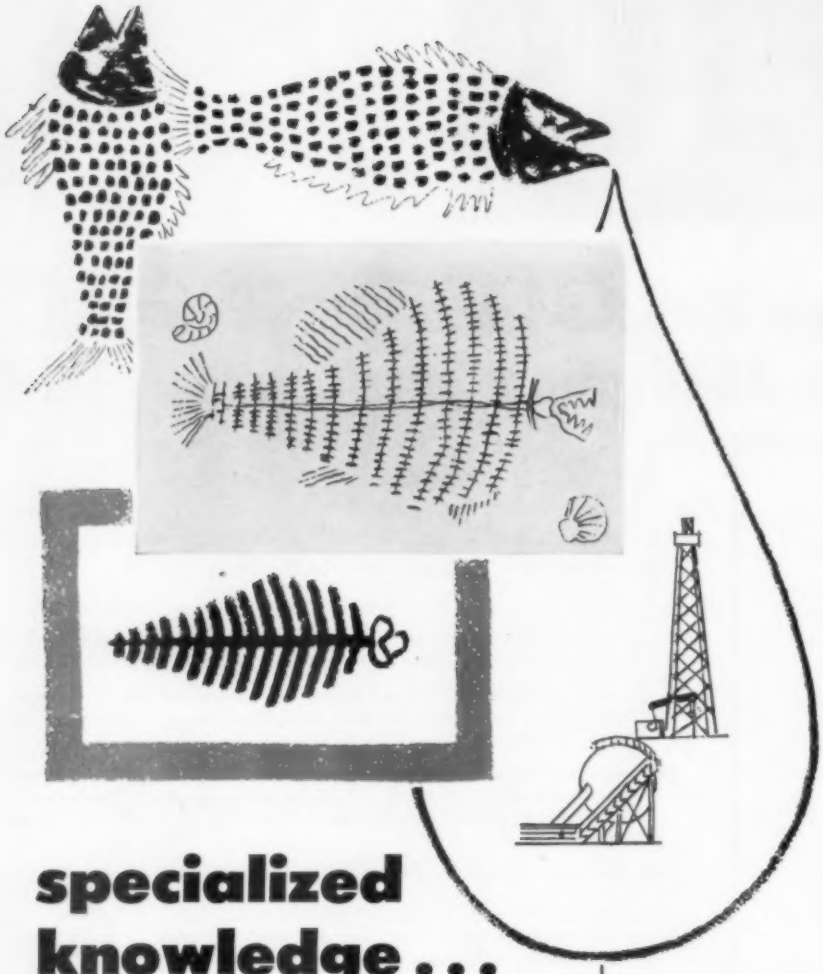
EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Oilfield Equipment Division, Dept. 1-A6

P. O. Box 1714 Oklahoma City, Okla.



specialized knowledge . . .

of the oil industry
is important to sound
financing of oil operations.
That's why you hear more and
more oil men say:

"for my money . . . it's THE FORT WORTH NATIONAL BANK"

FWNB

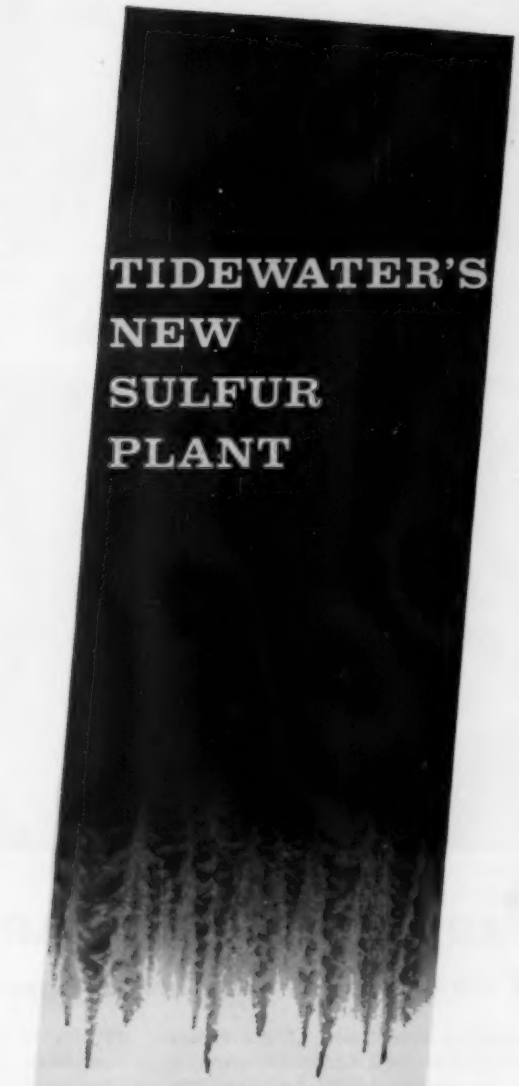
CAPITAL AND
RESERVE ACCOUNTS
OVER $20 MILLION

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

HELPING BUILD A GREATER
FORT WORTH AND SOUTHWEST

America's Largest

TIDEWATER'S NEW SULFUR PLANT



The H_2S Sulfur Recovery Unit at Tidewater's Refinery, near Delaware City, is one of 37 by Parsons. It is the first ever designed to operate from one-quarter to full capacity.

Parsons is proud to have had a part in Tidewater's Refinery – which is capable of handling the widest range of crudes – the largest ever built at one time.

PARSONS

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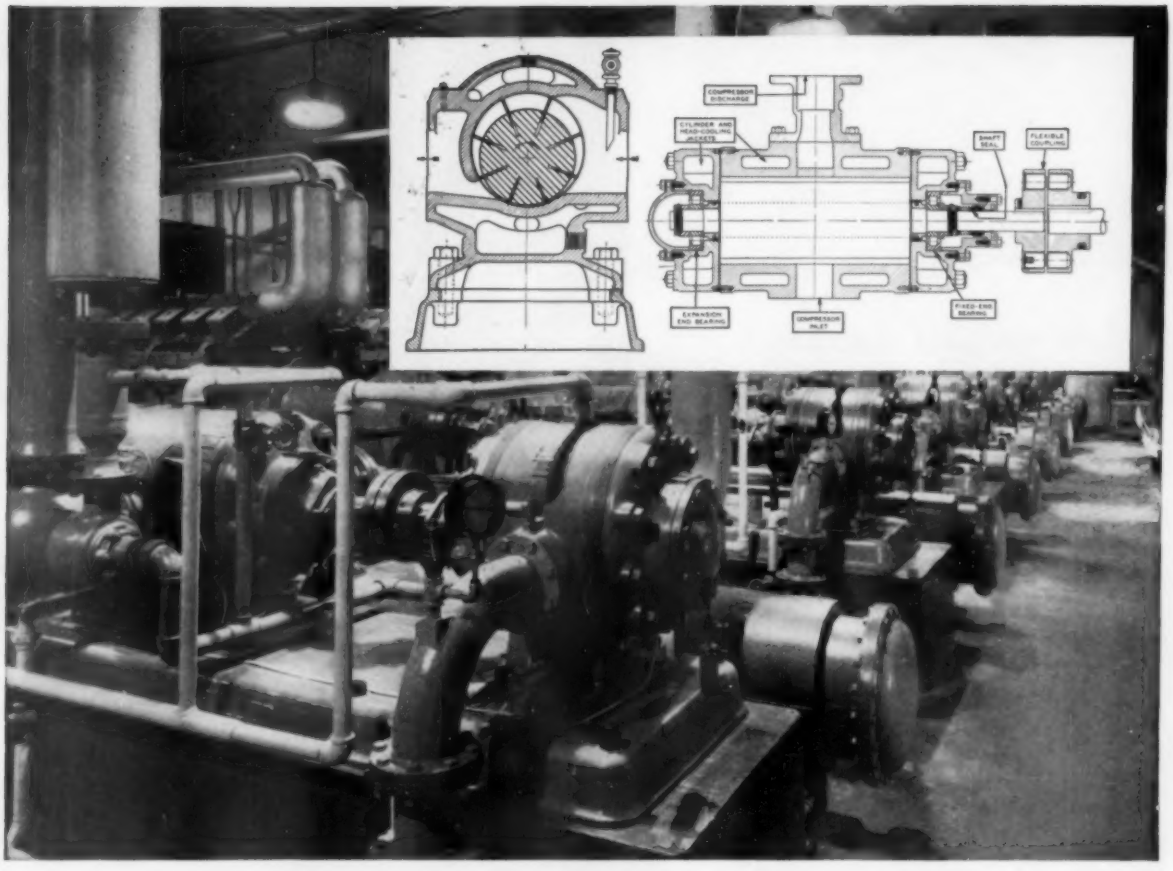
LOS ANGELES



HERE ARE 7 FULLER ROTARY COMPRESSORS

. . . in *any* quantity they are an investment in dependability

The wide and continuing acceptance of the Fuller Rotary Compressor in the petroleum industry is based on a number of unique design features, eminently suited for gas gathering and boosting in any rugged situation. Indoors or out, its trouble-free operation makes for minimum maintenance and operating costs.

There are 8 good reasons why the Fuller Rotary Compressor enjoys such widespread use—they may easily serve as reasons why your next compressors should be Fuller Rotaries.

1. SIMPLICITY—Elimination of compressor valves, crankshafts, pistons and other moving parts greatly reduces the need for attention, adjustment and replacement. 2. PULSATION-FREE FLOW—Rotary compression eliminates pressure fluctuations and simplifies metering problems. 3. SUSTAINED PERFORMANCE—Blades are held out by centrifugal force, automatically compensating for wear, thus maintaining new-machine efficiency and capacity. 4. NON-VIBRATING—Rotary principle permits a design completely free of reciprocating parts, avoiding basic cause of vibration.

5. COMPACTNESS—Large capacity in relation to size results in lighter weight, compact, transportable units. 6. EASE OF INSTALLATION—In smaller sizes, no foundation is needed. Larger units need only concrete slab for foundation. Automatic safety controls are incorporated in package. 7. ECONOMY—Few moving parts of the compressor, and their accessibility, reduce maintenance to the minimum. 8. VERSATILITY—Unit can be operated at various conditions. Capacity variation of 50% can be obtained by change of speed with engine, turbine, or two-speed motor drives.

We'd like to send you fully-descriptive Fuller Compressor literature. It's yours for the asking.

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PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

REHABILITATING INJURED WORKERS

Helping others to help themselves... Assisting the injured and handicapped to return to personal independence... Helping reduce the costs of workmen's compensation insurance... These are some of the gratifying results of one of the important services provided by the Texas Employers' Insurance Association — A rehabilitation program for workers handicapped as the result of industrial accidents.

Under the direction of our Medical Coordinator, several registered nurses, specially trained in rehabilitation work, are employed to coordinate the efforts of doctors, hospitals, therapists, the injured worker, his family and employer... in rehabilitating the injured worker and returning him to employment in the shortest time, with the least disability. Last year thirty-two such cases were handled with excellent results.

This is just one of the extra services rendered by Texas Employers' Insurance Association, Texas' largest writer of workmen's compensation insurance. Why not take advantage of your opportunity to obtain such services?

For full information, call or write our nearest service office listed below, or write direct to:

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Outstanding opportunities in Sales, Claims, Engineering and other departments for qualified young men.

TEXAS EMPLOYERS
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HOME OFFICE Employers Insurance Building DALLAS, TEXAS

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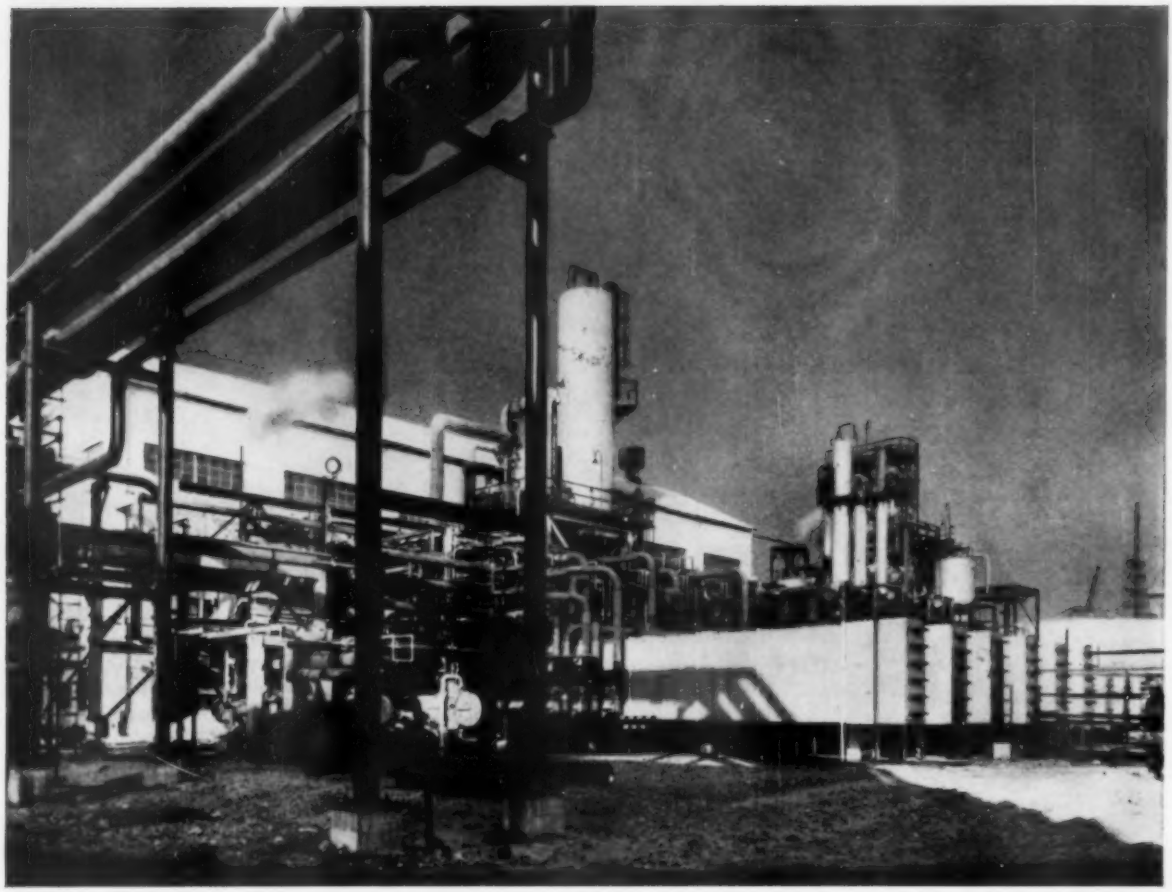
dewaxing-deoiling

...5800 bbls/day



RECENTLY completed for a large Midwestern refiner, this modern MEK Dewaxing-Deoiling plant will process in blocked operation both waxy distillates for wax removal and oily waxes for oil extraction. It is designed to produce zero and lower pour point oils and waxes meeting trade oil content specifications. Foster Wheeler supplied process and mechanical design, engineering and construction.

Foster Wheeler's long experience in this specialized field is your best assurance of complete satisfaction, from initial planning to final installation and on-stream service. Foster Wheeler process design engineers offer more than 20 years of continuous and cumulative experience in lube oil manufacture. Their intimate knowledge of all phases of design, engineering and construction — plus their close relationship with all licensor companies — can save time, effort and expense in any expansion or modernization program. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

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CONVERTS LOW COST CRUDES
INTO HIGHLY EFFECTIVE
FRACTURING FLUIDS

HALLIBURTON'S

VIS·O·FRAC TREATMENT

Lease crudes are chemically converted into low-cost fracturing fluids with Halliburton's Vis-O-Frac process . . . and all types of oil and gas producing formations have been effectively fractured with this treatment.

A good sand-carrying gel is continuously formed from almost any type crude . . . yet friction resistance to movement through tubing or casing is especially low. Vis-O-Frac has good viscosity index, indicating little change with increased temperature. Fluid loss is rated low. Stable under agitation. Practically no clean-up problem.

Best way to get profitable fracture is to rely on experienced, successful Fracturing personnel. Halliburton, the pioneer in oil well fracturing, has successfully fractured more wells than any company in the world. Call your local office or write Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

OIL WELL CEMENTING COMPANY • **PIONEERS IN FRACTURING SERVICES**

DUNCAN, OKLAHOMA — 251 SERVICE CENTERS • JUST MINUTES AWAY FROM ANY RIG

Why General Electric Drive Proves Best For Oil Well Drilling Rig Electrification

1 Control simplicity inherent in motor and generator design. General Electric's differential generators eliminate the need for complicated external current and voltage regulating controls, feed-back systems, and torque limiting devices used in some makes of electric drive. Moreover, General Electric's familiar air throttle system eliminates the individual exciters for each generator. The G-E shunt motor will not run away in case of load loss and therefore requires no speed-limiting control devices. This motor has excellent braking characteristics without any added controls. All control provided for the General Electric drive system assures complete regulation of speed and torque simply and efficiently.

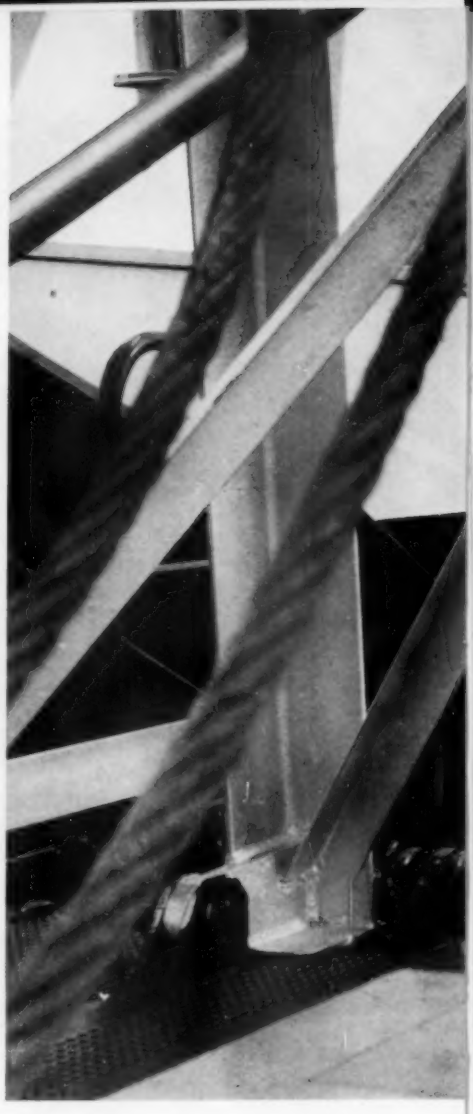
2 Can be used with almost any popular oil field engine. A great number of popular oil field engines can be used with General Electric drive including spare engines which you may have in stock. The advantage here is that preference for and familiarity with a particular make of engine need not be sacrificed to gain the benefits of this reliable, efficient, low-maintenance drive system. Parts programs need not be complicated by the addition of a different line. General Electric and the engine builder co-operate so that engine-generator sets are furnished as a completely engineered package. G.E. has two generators available for oil field applications. The GT558R1 generator is a single-bearing, flange-mounted, self-ventilated machine with the following input horsepower ratings: 200 hp at 1200 rpm, 240 hp at 1400 rpm, 280 hp at 1600 rpm, 320 hp at 1800 rpm, 340 hp at 2000 rpm, 350 hp at 2100 rpm. The GE752J generator is a two bearing, single shaft, separately ventilated generator. (It is also available as a two shaft extension machine.) This generator has the following input horsepower ratings: 450 hp at 850 rpm, 550 hp at 900 rpm, 600 hp at 1000-1300 rpm. The GE752H2 motor rates 625 hp continuously and up to 1000 hp for hoisting at 950 rpm.

3 Designed and built by the original manufacturers of electric drive. General Electric is primarily an electrical equipment manufacturer with years of experience in the manufacture of electrical apparatus. The simplicity and flexibility which mark General Electric drive are the result of leadership in the electrical field. The electric drive that will mean so much to your rig operation and to your cost per foot of hole has been pioneered and developed by G.E.

For more information, call your nearest G-E Apparatus Sales Office. (Principal drilling offices in Dallas, Houston, New Orleans, Denver, Tulsa, and Los Angeles.) Locomotive and Car Equipment Department, Erie, Pa. 115-22

Progress Is Our Most Important Product

GENERAL ELECTRIC



PRINCIPAL

GT558R1 direct current main generator with inspection covers removed.

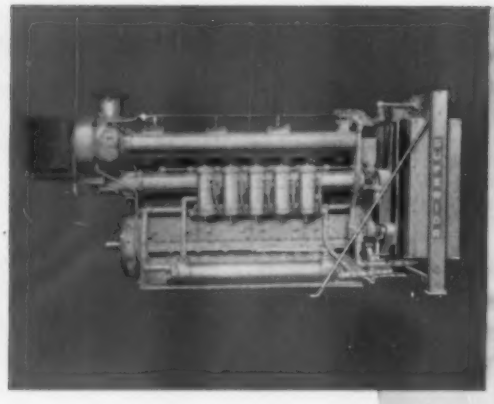
Operator at drilling controls of General Electric equipped rig built for Shell Oil Company by Ideco, one of the Dresser Industries. Standard air throttles are used for speed controls. These can be incorporated in the draw works console with other air controls, simplifying operation.

GENERAL ELECTRIC DRIVE COMPONENTS:

GE752J direct current main generator with top-mounted blower assembly.

GE752H2 direct current, 1000 hp motor with top-mounted blower assembly.

General Electric control console for use at driller's position.



powered by White's Superior Diesels . . .

SHORELINE'S RIG 7 DRILLS TO SUPER-DEPTHS

Tremendous depths, restricted only by present drill pipe and drilling methods, are reached by Shoreline Drilling Company's new Marine Rig 7, located in the West Delta Area off the Louisiana Coast. For prime power on this isolated Gulf platform, where drilling is being done for the CATC Group, Shoreline wisely chose three White PTDS-8 Supercharged Superior Diesels, each rated at 800 B.H.P.

Greater operating economy and dependability with White Diesels assure more profitable and continuous development drilling. Moreover, the up to 30% power increase in the newly improved Super PTD's gives greater working ability, more lugging power and faster acceleration. Yet engine size is not increased, resulting in less weight and less cost per horsepower.

Many other new design and engineering features make White Diesels outstanding for rugged, efficient, low-maintenance service. Superior Diesel, Dual Fuel or Gas oil field engines are available from 320 to 2150 B.H.P. Get the facts from leading rig manufacturers, White Diesel representatives in oil field areas, or the White Diesel Engine Division general office.

White Diesel

WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY

Plant and General Offices: Springfield, Ohio

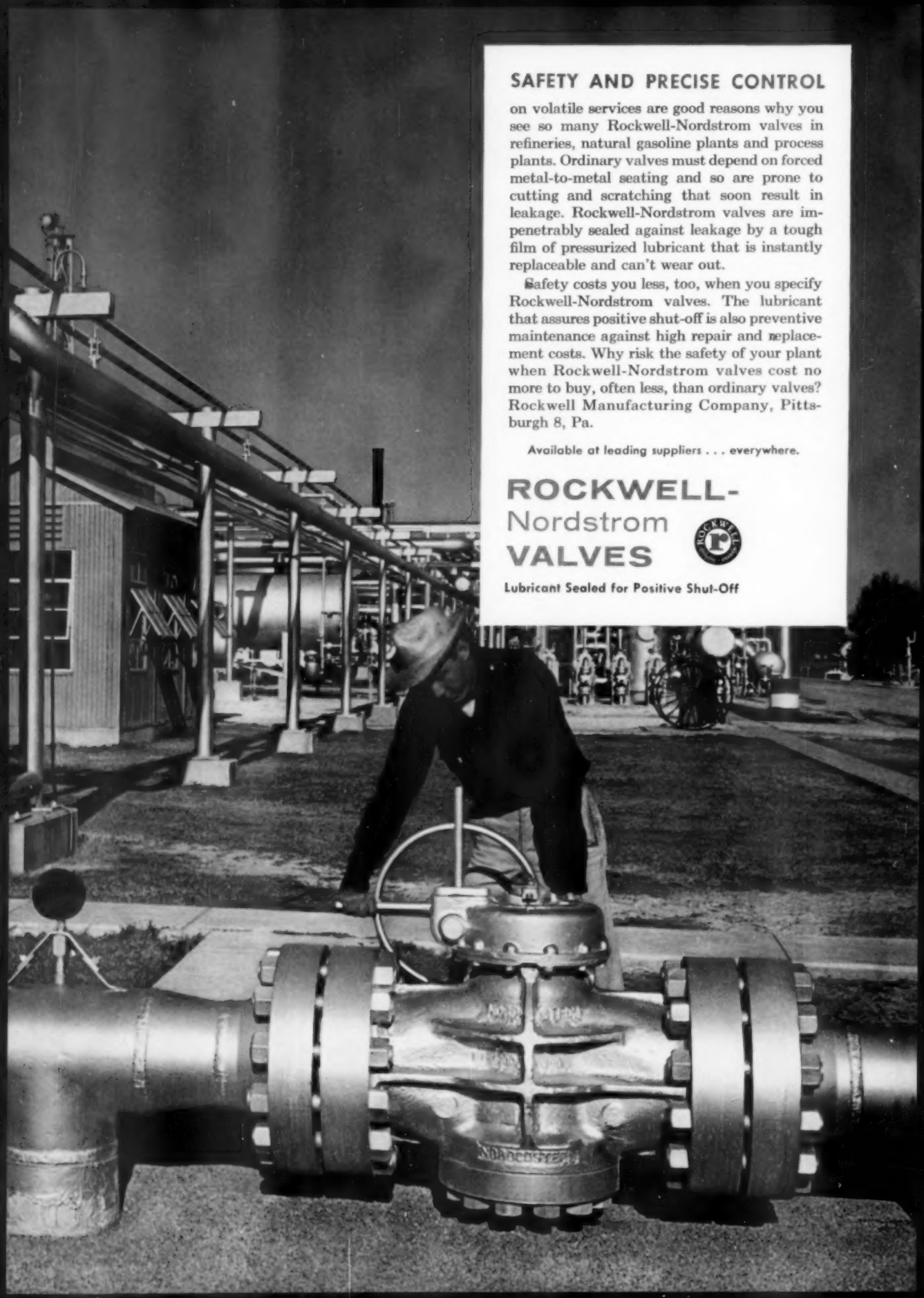
INSTANT, DEPENDABLE RESPONSE to push button or automatic flow control is assured when you specify Rockwell-Nordstrom valves. Their basic advantage for power operation that is lacking in ordinary valves: *lubrication*. Because the plug is seated on a film of pressurized lubricant, a "friction-free" surface keeps the valve ready for instant, smooth operation. And since the lubricant reduces torque and the plug is fully open or closed in a quarter-turn, a simpler, less costly actuator is needed.

Rockwell-Nordstrom valves are available in a complete range of sizes and pressure ratings with electric, pneumatic and cylinder operators. They cost no more to buy—often less—than ordinary valves. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Available at leading suppliers . . . everywhere.

ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed For Positive Shut-Off



SAFETY AND PRECISE CONTROL

on volatile services are good reasons why you see so many Rockwell-Nordstrom valves in refineries, natural gasoline plants and process plants. Ordinary valves must depend on forced metal-to-metal seating and so are prone to cutting and scratching that soon result in leakage. Rockwell-Nordstrom valves are impenetrably sealed against leakage by a tough film of pressurized lubricant that is instantly replaceable and can't wear out.

Safety costs you less, too, when you specify Rockwell-Nordstrom valves. The lubricant that assures positive shut-off is also preventive maintenance against high repair and replacement costs. Why risk the safety of your plant when Rockwell-Nordstrom valves cost no more to buy, often less, than ordinary valves? Rockwell Manufacturing Company, Pittsburgh 8, Pa.

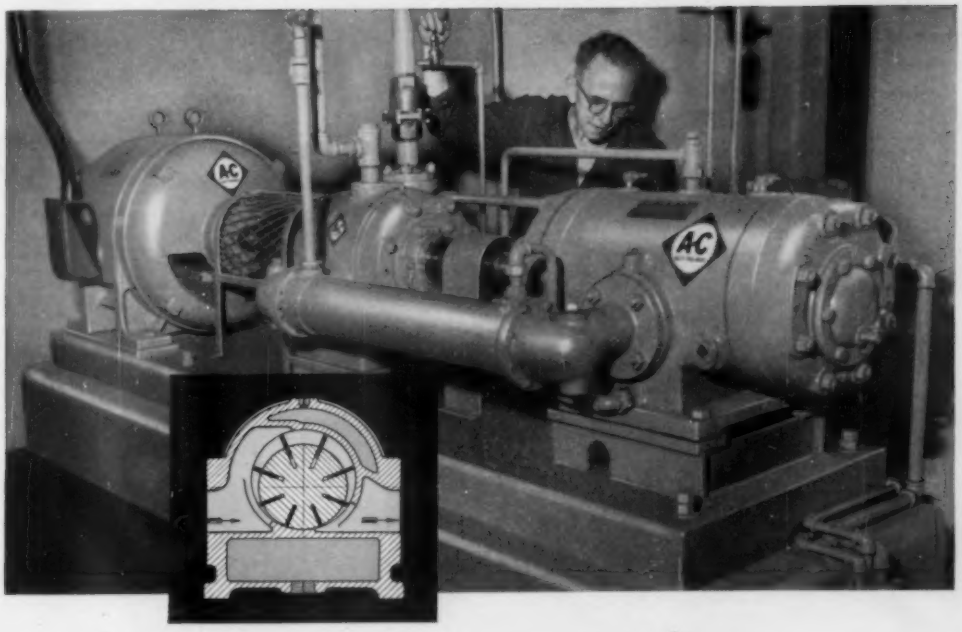
Available at leading suppliers . . . everywhere.

ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed for Positive Shut-Off

RO-FLO

Compressors cut vibration . . . eliminate wear and fear



Low maintenance is one of 4 advantages

ROTARY motion and fewer parts reduce maintenance costs to a minimum. Lack of vibration and shock, plus the absence of reciprocating parts — pistons, valves, connecting rods — eliminates major causes of trouble.

Other advantages are:

Constant efficiency — During operation the sliding vanes of the rotor press outward against the cylinder wall to form air cells (as shown in drawing). The rotating force holds vanes tightly against the cylinder wall under all conditions, and air cell size, air flow, and efficiency always remain constant.

Compactness — No extra weight or size needed to dampen vibration.

Low-cost foundations — Smooth operation eliminates need for heavy, costly foundations. Small units are bolted directly to floor . . . large units need only a simple slab.

Many Types and Sizes

Single-stage units for pressures to 50 pounds gauge, and volumes from 42 to 3245 cfm. Two-stage units for 250 to 1800 cfm at pressures from 60 to 125 pounds gauge.

Single and two-stage vacuum pumps for vacuums to 0.3 inch mercury absolute from 22 to 5950 cfm.

For Information — Call your nearby A-C office or write for Bulletin 16B8244 (two-stage) and 16B-8126 (single-stage). Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

Ro-Flo is an Allis-Chalmers trademark

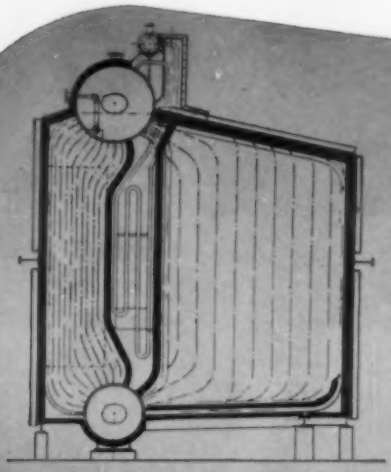
ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5354

More Steam with Fewer Dollars

Vogt TYPE VV-S STEAM GENERATORS



Section thru Type VV-S unit.

Two 50,000 #/hr. units under erection at an Air Force Base.

A 65,000 #/hr. unit in a Texas Petroleum Refinery

- ★ Headerless construction for full unrestricted water circulation.
- ★ Large water storage capacity and correspondingly greater steam relieving space.
- ★ Long, narrow furnace ideal for oil or gas fuel.
- ★ Completely steel encased for "out-in-the-open" operation.
- ★ Simple slab foundation.
- ★ Capacities from 50,000 pounds to 100,000 pounds steam per hour.

OTHER VOGT PRODUCTS

Drop Forged Steel Valves, Fittings and Flanges—
Petroleum Refinery and Chemical Plant Equipment
Heat Exchangers
Ice Making and Refrigerating Equipment

HENRY VOGT MACHINE CO.

Box 1918, Louisville 1, Kentucky

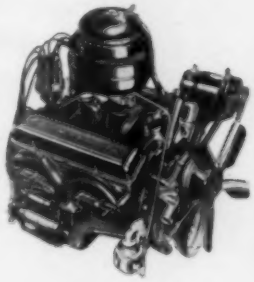
SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati

POWERFUL REASONS WHY A CHEVROLET STAYS ON THE JOB...SAVES ON THE JOB!

COMPACT CHEVY V8

(weighs up to 150 lbs. less than others)

- Shortest stroke of any truck V8
- Short, durable connecting rods
- Vertically compact cylinder block
- Rugged yet light crankshaft
- Efficient hydraulic valve lifters
- Long-wearing Moraine bearings



Chevrolet trucks are powered by V8's that make every ounce count. Because of their trimmed-down design, they use less power to haul their own weight and put more power into hustling your cargoes. Like all Chevrolet truck components, these engines are efficient performers—and that means top economy and dependability!

Chevy's the dollar saver *de luxe* of the American road, and many of the reasons why can be found beneath the Chevrolet truck hood. That's where you'll often find a great V8 that's at the head of its class for compact, *efficient* short-stroke design. You won't find features to equal all those listed here (at left) in any other truck V8's today. Or, if you prefer a 6, Chevy's got the most popular 6-cylinder powerplants in the history of hauling. They're honest-to-goodness *truck* engines, specially built to *stay* and *save* on rough, tough hauling jobs.

You'll find that a Chevrolet truck gives you *so much* to save with! Your Chevrolet dealer is waiting to fill you in on all the facts. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

Biggest sellers . . . because they're biggest savers! CHEVROLET

CHEVROLET TASK·FORCE 57 TRUCKS

24-Hour Tour

The oil industry keeps hours . . . 24 in every day. And it drills and completes wells at all hours and in all places—next door to cities, but also in the marshes, in the mountains, under the ocean. Efficient field service is difficult, but an absolute necessity.

America burns a lot of oil at midnight.

Maybe it's in the form of kerosene . . . in a lamp to light the shack of a trapper in the wilderness.

Or, perhaps it's the kind of oil that provides fuel for generators . . . generators that provide another kind of light and tremendous power for industries, power for the home.

Maybe the oil propels a ship, lights a buoy, keeps emergency vehicles operating.

People drill at midnight, too. They must, if the power needs of America are to be met.

They drill at noon, too; yes, around the clock.

They drill deep and shallow and tap big oil and gas pools and little pools.

All of this drilling—at all hours, in all weather, under all kinds of conditions—requires not just equipment, but specialized equipment. And equally important, specialized service.

That's why the Oil Center Tool Company has come to play such a big and vital part in the oil patches wherever they may be.

O-C-T equipment is precision-designed and engineered, precision-made and precision-installed.

Field service has distinguished the company as much as the equipment itself.

O-C-T field engineers and service men, as close as the telephone, always are available for expert installation at any location, at any time, in any weather.

They get the job at hand done . . . quickly and efficiently.

But they're always looking ahead, these O-C-T men.

Completion problems of tomorrow are their problems.

That's why O-C-T field men keep such close contact with oil company engineers and drilling and production supervisors—to develop better equipment.

A problem encountered in the birth of a new oil or gas well today may mean the birth of a new O-C-T product tomorrow.

At midnight, noon or 4 A.M. in the coyote country of West Texas, the altitude of the Rockies, the marshes of Louisiana, the spray of the Gulf of Mexico, O-C-T men are available.

Available with the best techniques and the best equipment.

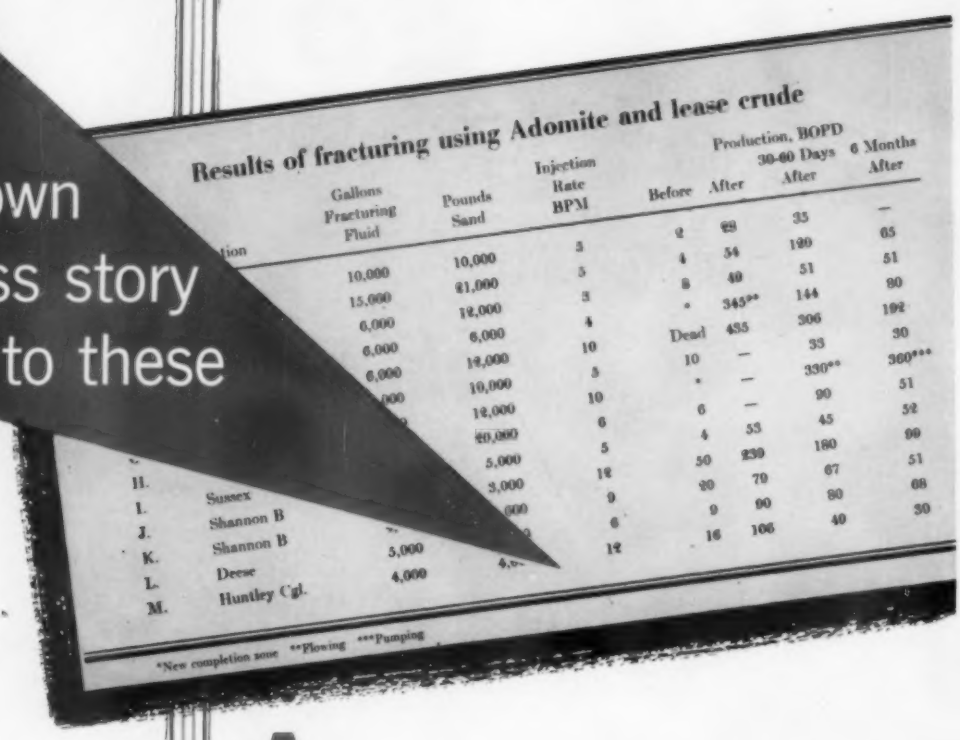
O·C·T

OIL CENTER TOOL CO.

Export Representatives: South America—East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

It's 9 p. m. The hanger is in place and the O-C-T Service Engineer at left is aided by a member of the drilling crew as the first unit of the well control system is put into place. At midnight this O-C-T man was on another well, in another field. He is always available, like all O-C-T service and sales personnel—regardless of the time or type of job.

Add your own success story to these



Results of fracturing using Adomite and lease crude

		Gallons Fracturing Fluid	Pounds Sand	Injection Rate BPM	Production, BOPD Before	After	30-60 Days After	6 Months After
		10,000	10,000	3	2	29	35	—
		15,000	21,000	5	4	54	190	65
		6,000	12,000	3	8	40	51	51
		6,000	6,000	4	*	345**	144	90
		6,000	12,000	10	Dead	435	306	192
			10,000	5	10	—	33	30
			12,000	10	*	—	330**	360***
			20,000	6	6	—	90	51
			5,000	5	4	55	45	52
H.	Sussex		3,000	12	50	230	180	99
I.	Shannon B			9	20	70	67	51
J.	Shannon B			6	9	90	80	68
K.	Deese	5,000	6,0-	12	16	106	40	30
L.	Huntley Cgl.	4,000						
M.								

*New completion zone **Flowing ***Pumping

fracture with Adomite

Adomite®—and only Adomite does so many things so effectively

Seals the fracture face . . . minimizes fluid loss . . . no damage to formation.

Longer fractures . . . deeper penetration of sands.

Fewer sandouts . . . reduces fluid loss in rock matrix, prevents buildup of sand concentrations in the fractures.

Saves you money . . . utilizes your own lease crudes . . . saves transportation costs.

Decreases friction loss . . . low viscosity of Adomite-created fracturing fluids permits use of less pumping equipment than with viscous refinery residuals.

Reduces hazard of emulsions . . . emulsion-breaking characteristics are important consideration to many producers.

Adaptable to virtually all types of crude, Adomite is all you need to control fluid loss of kerosene, crudes, gelled crudes or refinery residuals.

Producers who say Adomite . . . stay with Adomite.

Get greater profits from your next fracturing job—

TELL YOUR SERVICE COMPANY TO USE Adomite

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J&L pipe delivers dependable service

J&L tubular products pass the most critical gas industry test of all . . . service on the job. Long and dependable pipe life is assured through J&L's exacting quality control, extensive research and testing.

Specify J&L drill pipe, casing and tubing for gas well drilling and production, J&L line pipe for gas transmission and distribution. When you buy J&L tubular products you buy long, dependable service on the job. Buttweld, lapweld, seamless and Electricweld are available in size ranges from ½" to 14" O.D.

Write today for complete information on the J&L line of tubular products. Jones & Laughlin Steel Corporation, Department 416, Three Gateway Center, Pittsburgh 30, Pennsylvania.

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Oklahoma has produced more than one-seventh of all the oil ever produced in the United States! Last year its rich earth yielded a daily average of 585,415 barrels of oil from 75,756 wells.
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Oil serves you every minute of every day — May we do the same for you in a financial way?
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GRACE

By Glenn Taliaferro
Johnston Testers

FOR MORE INFORMATION AT THE BOTTOM OF YOUR WELL

FIVE Important Points of D. S. T. Pressure Charts

The science of reservoir engineering is putting greater demand on the field engineer for understanding and interpretative knowledge of Drill Stem Test Pressure Charts. Technical reservoir information can be enhanced by utilizing drill stem test data.

Realizing there is a need for proper evaluation of such data, Johnston Testers is complying by furnishing to the industry a pressure chart combining both "expanded" time and "expanded" pressure. Figures A and B illustrate the same chart, Figure A having the advantage of "expanded" time and "expanded" pressure to aid in the interpretation. By placing Figure A on a *reduced time* scale and removing the *extra inches* of deflection Figure B is produced.

Although Figure A presents a rather complicated appearance, it is simplified by realizing that

1. The chart progresses from right to left and that
2. When a pressure line reaches the left extremity of the chart it will reappear AT THE SAME PRESSURE READING ON THE RIGHT SIDE.

Points of interest on Figure A

1. Initial hydrostatic mud pressure.
2. Initial flowing pressure.
3. Final flowing pressure.
4. Final shut-in pressure.
5. Final hydrostatic mud pressure.

Reading from right to left, the pressure chart indicates the build-up hydrostatic pressure as the testing assembly is lowered in the hole. Upon reaching bottom the initial hydrostatic head of the mud column is recorded in pounds per square inch as indicated at point "1".

With the testing assembly on bottom, weight is applied and the packer is expanded isolating the desired test zone.

After the packer expands, the test tool opens exposing the test zone to the conditions in the drill pipe. This allows the pressure to drop from the initial hydrostatic mud pressure at point "1" to the initial flowing pressure at point "2" and with this decrease of pressure on the test interval, the fluid in the formation is permitted to flow into the well bore.

As the fluid flows from the formation through the perforated anchor and into the drill pipe, the pressure recorders accurately record the increase of pressure from the initial flow pressure at point "2" to the final flow pressure at point "3".

Any changes in pressure during the flow period will be recorded whether they are caused by tool manipulations or formation characteristics and will be easily identified on the flow curve. Examples of these pressure changes during the flowing period could be changing chokes at the surface, partial or complete plugging during the test, operating the equalizing valve to unplug the test tool.

After the well has been flowing for the desired length of time, the shut-in valve in the testing assembly is closed by rotating the pipe to the right. The small volume in the tester assembly from the shut-in valve to the bottom of the hole allows a rapid build-up toward the formation or reservoir pressure and the final shut-in pressure is recorded at point "4".

After the shut-in period is completed the equalizing ports are opened, allowing the mud to flow below the packer, facilitating easy removal of the packer from the packer seat. As the mud equalizes below the packer, the pressure increases to the final hydrostatic mud pressure at point "5" and as the tester is removed from the hole the chart shows the decrease in pressure and returns to the base line as the test tool reaches the surface.

All the pressures measured and recorded are due to the "actions" of various fluids encountered or controlled by the Tester. Mechanical operations, such as sudden changes in running speed, jarring, and so on, will record as vertical lines (pressure) very short time intervals. These lines will not confuse the actual test pressures as they are readily recognized as forces other than those caused by the formation.

For more comprehensive interpretative data write Johnston Testers for the booklet entitled "The Interpretation of Drill Stem Test Data."

FIGURE A

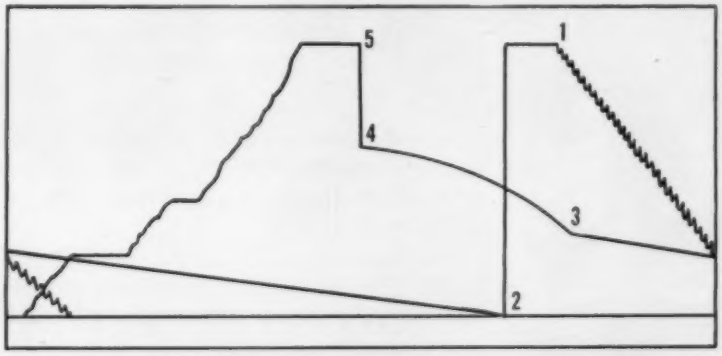
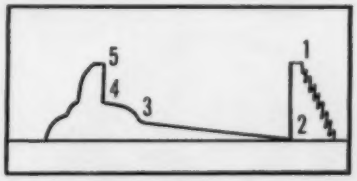


FIGURE B



GLENN TALIAFERRO
Manager of Chart Dept.
Johnston Testers
Houston, Texas

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CONSOTROL* RECORDING

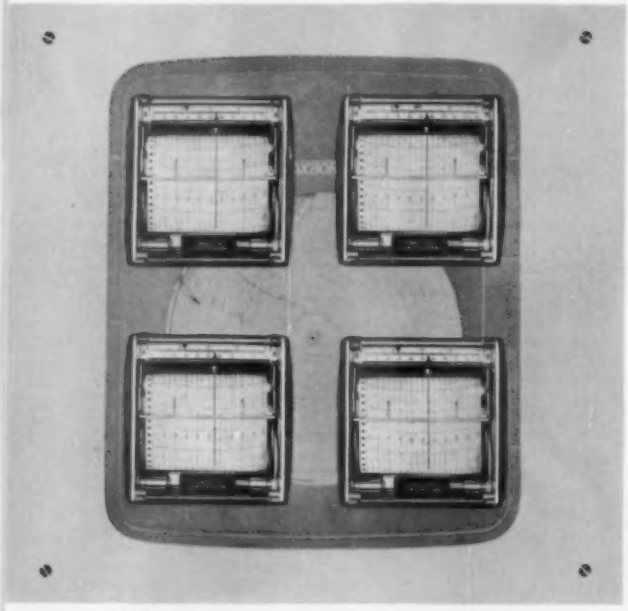

Illustration shows how 4 Consotrol Instruments require less panel space than does a single, conventional 12" recorder.

The ORIGINAL small-case control panel instrument with a FULL SCALE 4 INCH CHART...

Full-scale *readability!* Here is the industry standard set by Consotrol Instruments, with no compromise in compactness, convenience, or performance.

These Recorders and Recording Control Stations are so compact you can actually mount 4 in the space required by 1 standard 12-inch recorder. And yet, inside the case, all components are full size — nothing is "miniature."

With the integrally mounted Model 58 Controller, the Foxboro Consotrol Recording Control Station provides precise, dependable control and full-scale chart records in one-quarter the panel space. Maintenance is easier too, with all calibration adjustments made from the front . . . re-inking needed only twice a year . . . chart changes as seldom as once a month.

For the complete story, write for Bulletin 13-18. **The Foxboro Company, 606 Neponset Avenue, Foxboro, Massachusetts, U.S.A.**

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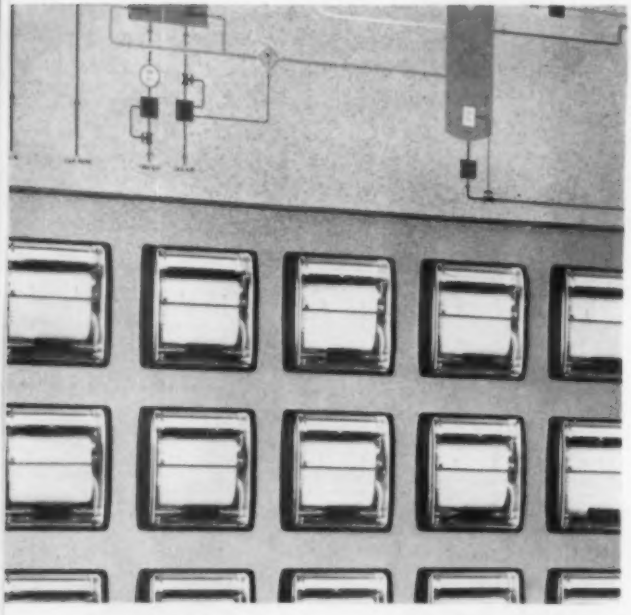


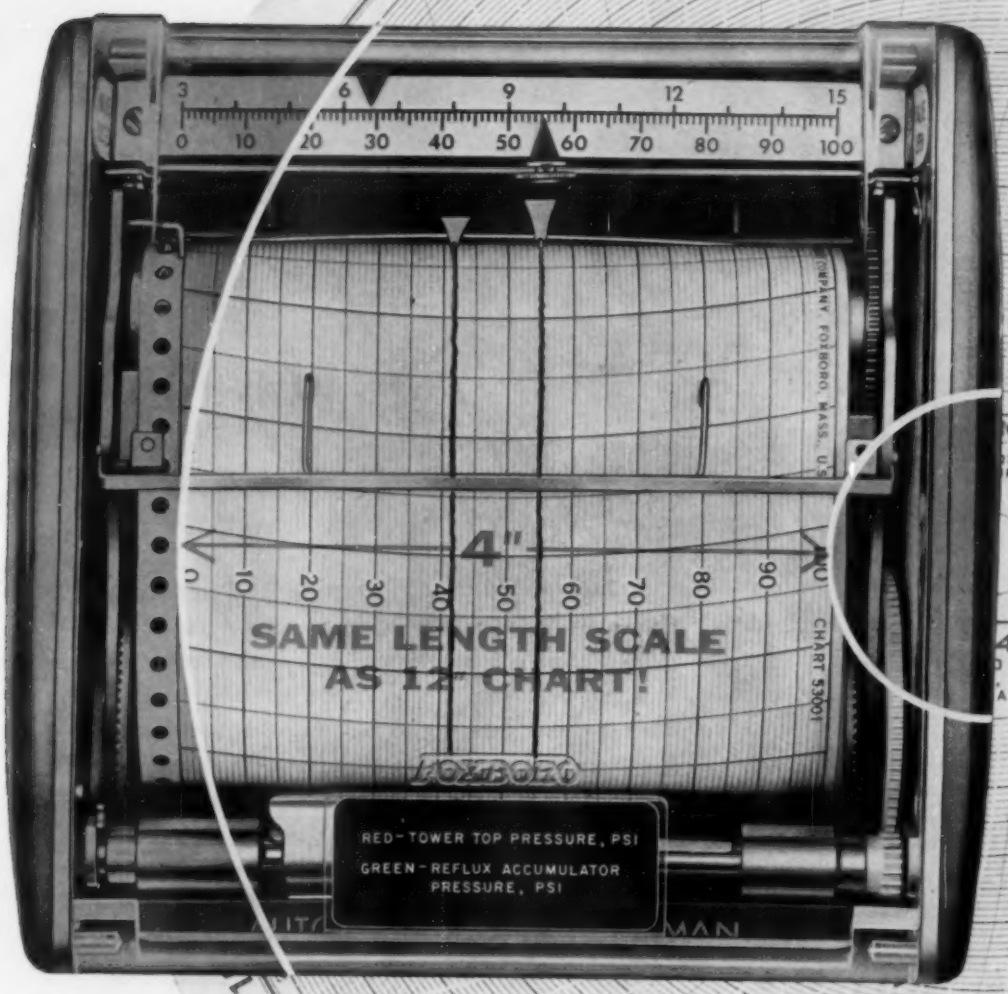
Typical control panel showing Consotrol Recording Control Stations. Associated M/58 Controllers, integrally mounted, pull out with the recorders.

*Reg. U.S. Pat. Off.

FOXBORO

REG. U.S. PAT. OFF.

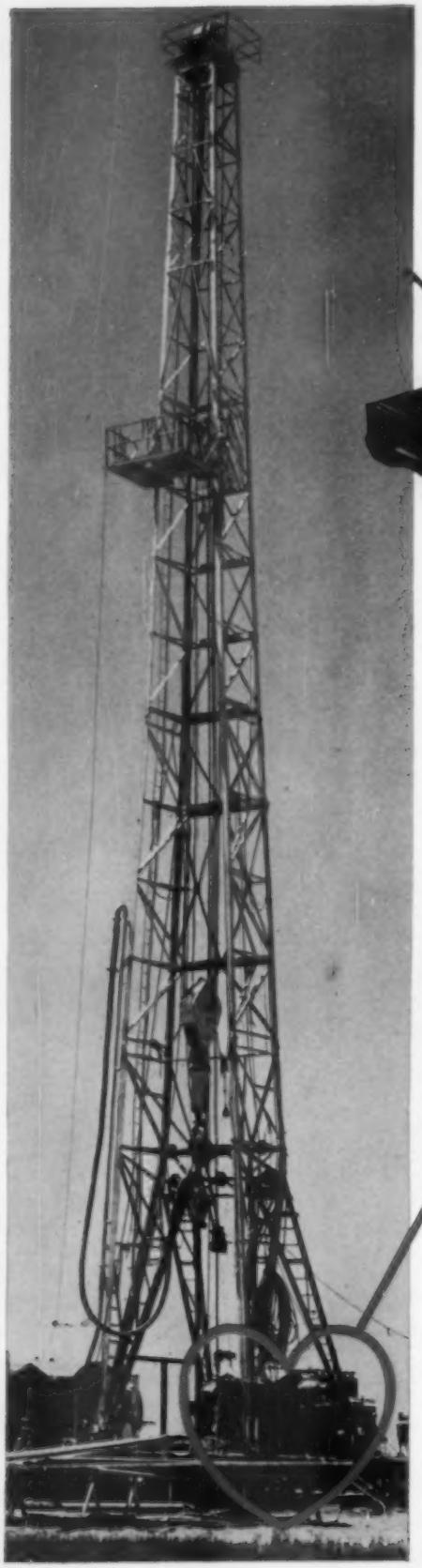
CONTROL STATION

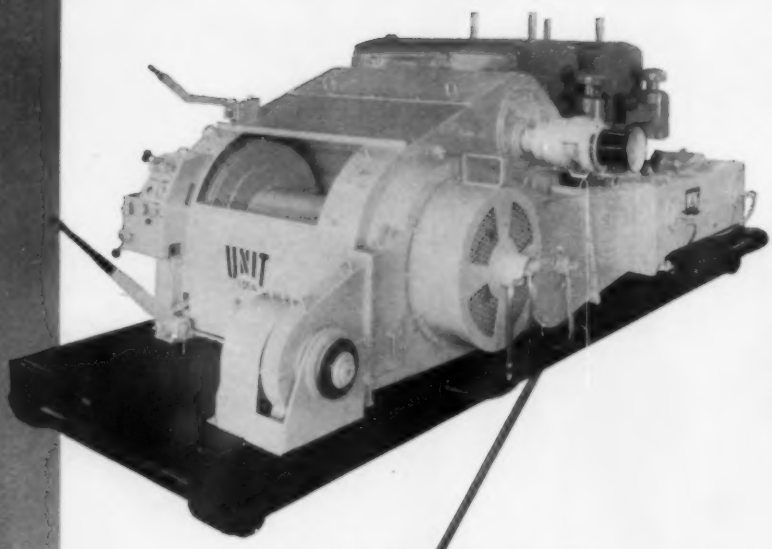


ACTUAL SIZE illustration of Consotrol Instrument super-imposed on standard 12-inch chart. Note full 4" wide strip chart has same length scale as 12" circular chart.

CONSOTROL INSTRUMENTS

RECORDING · CONTROLLING · INDICATING





There's ECONOMY at the Heart of this Rig

U-36-A Unit Rig drawworks provides economy because it is engineered for fast drilling, extra depth capacity and convenient rig moves. While rated at 300 to 600 horsepower input, the No. 1 U-36-A, drilling in Wyoming, completed its first field well at 9,248 feet. In the Texas Panhandle, an oil operator using a U-36-A is consistently making hole at record rates. Contractors and oil operators who purchase Unit Rigs regularly get greater dollar value with the extra "built-in" capacities. For complete details on a Unit Rig for your requirements, contact your Mid-Continent representative.

Write for U-36-A Bulletin

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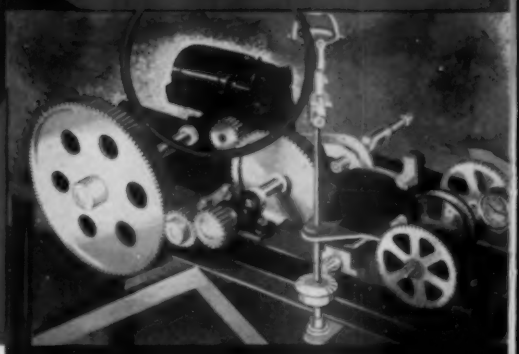
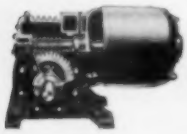
Nothing Cuckoo about this clock!



The "works" of a tower clock. ⅓ H.P., 115/230 volt, 60 cycle, 1 phase Master Right Angle Gearmotor supplies main drive with a synchronous output speed of 30 R.P.M.

You may not need clock drives, but time (production time) is a problem everywhere—and that calls for the most dependable, most efficient use of electric drives—like here! This clock, with 300 lbs. of hands and four 24-foot dials is powered by a Master Gearmotor driving a precision gear train. With that accurate Master drive, here's a one-jewel clock!

Are you sure you've got the right answer to your drive requirements? Master components can be integrated in any combination to give you the right horsepower, right shaft speed, right mounting features, in a single, efficient, compact unit. Now's the time to let us prove it.



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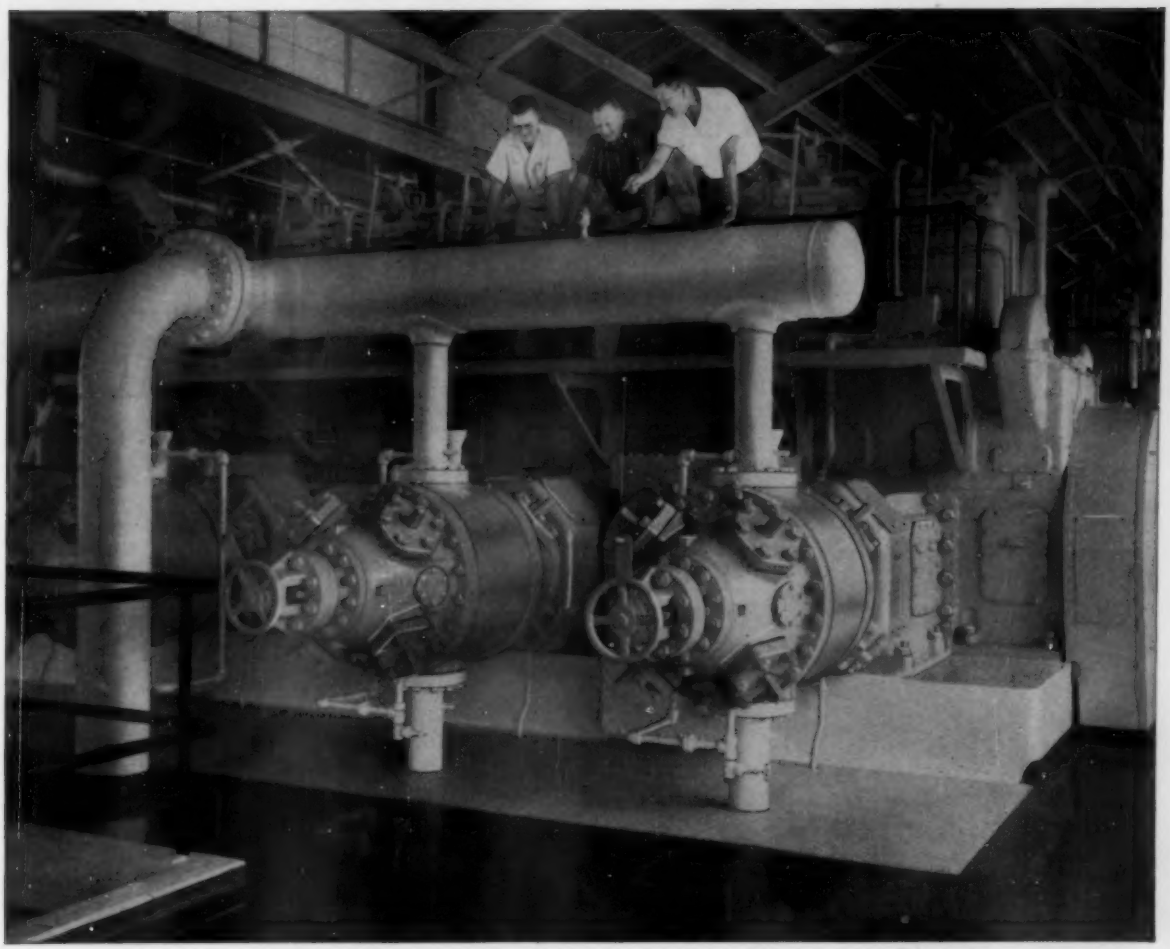
ANOTHER DRIVE REQUIREMENT MEETS ITS MASTER

Motor Ratings	⅛ to 400 H.P. All phases, voltages, frequencies.
Motor Types	Squirrel cage, slip ring, synchronous, repulsion-start induction, capacitor, direct current.
Construction	Open, enclosed, splash-proof, fan-cooled, explosion-proof, special purpose.
Speeds	Single-speed, multi-speed, and variable speed.
Installation	Horizontal and vertical, with or without flanges and other features.
Power Drive Features	Electric brakes (2 types)—5 types of gear reduction up to 432 to 1 ratio. Mechanical and electronic variable speed units—fluid drives—every type of mounting.

THE MASTER ELECTRIC COMPANY

Dayton 1, Ohio



Richard N. Rogers, Results Engineer (left), W. C. Drienhofer, Station Superintendent, and R. A. Cuyler, Jr., Gulf Sales Engineer, inspect one of the 31 units lubricated by Gulf Security since 1944.

At Tennessee Gas Transmission Company's Middleton Station . . .

Not a ring change in 26,800 hours with

GULF SECURITY OIL

31 gas engine compressor units have been running smoothly at the Middleton Station with Gulf Security Oil since 1944. The records show 26,800 hours operation without a single ring change. And after 85,000 hours, Security in the crankcase was still in excellent condition.

Here for 13 years Gulf Security has lived up to its name—security against operating troubles and high maintenance costs. Gas engine compressor units lubricated with Gulf Security are consistently free of heavy port and ring belt deposits. Wear is negligible—in fact, ring and liner life in both power and compressor cylinders is well above average. Bearings last longer, too.

When you use a Gulf product you get an extra dividend—the free services of an experienced Gulf engineer. He's always "on call" to assist you with any problem involving lubricants, fuels, or any other petroleum product. Write, wire or phone your nearest Gulf office.

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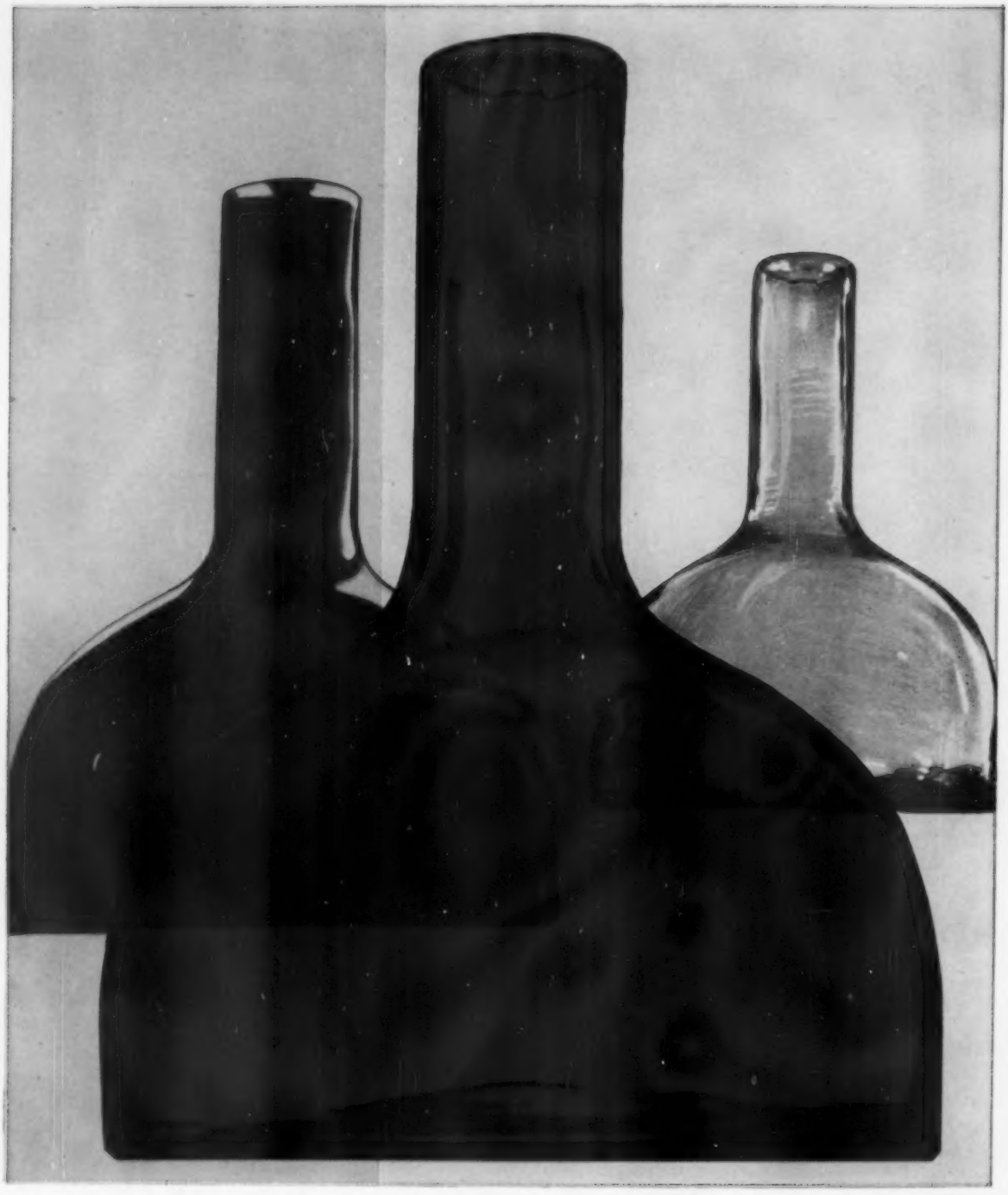

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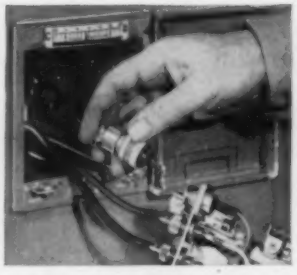

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. . . Finally, slide the chassis into the case, and your process is on automatic control.

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LET Honeywell *Tel-O-Set* recorders and indicators help you to start panel construction immediately. Here's how. Order the cases for the recorder and indicator now. Cases, available from stock, can be shipped separately to the panel manufacturer or to your plant site. Make complete piping connections, check air lines and valve operation . . . then install the chassis and controller later, at startup. They will always fit perfectly, because there are no plug-in projections or seal rings to be lost or damaged during shipment.

The indicator and recorder chassis don't have to be unpacked until you're ready for startup. That way, the instruments are fully protected against damage, and safeguarded from the dust and dirt that always accompany the final stages of plant construction.

Call your nearby Honeywell sales engineer for a discussion of this new shipping plan, and for more information about how *Tel-O-Set* instruments are easier to install, service, and operate. Or write for your copy of the new *Tel-O-Set* Catalog, No. C1001-1.

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"Numerous factors, both economic and political, are involved. We must be mindful that natural gas is subject to regulation and there is little free interplay of demand, supply, and price. To achieve deliverability of gas in the volume needed would require the expenditure of vast sums of money for exploration and development of reserves as well as transportation and distribution facilities.

"And there would have to be an adequate financial incentive. More costly gas could alter the competitive status of fuel oils and gas. And, since much of the outside gas supply would have to come from Canada, additional non-economic factors would be involved.

" . . . There have been no important natural-gas discoveries in California since before World War II. Production of gas reached a peak in 1948 and has declined since. Large scale receipts of gas from outside the West Coast commenced in 1947 and now exceed indigenous production . . .

"Indicated is the startling fact that 55 per cent of over-all energy requirements must be supplied from outside the area by 1966. That compares with 28 per cent in 1956 and only 2 per cent 10 years ago."

Kenneth E. Hill, vice president, Chase Manhattan Bank, New York, in a speech before the American Petroleum Institute Division of Production, Pacific Coast district.

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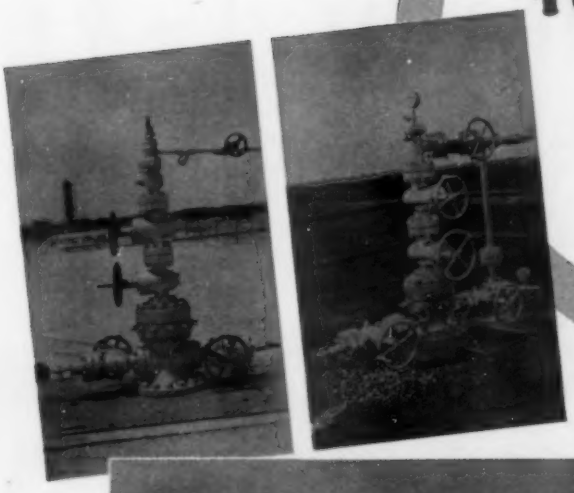
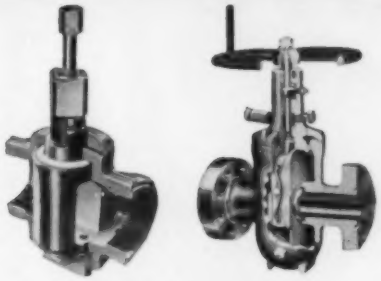
high PRESSURE and low PRESSURE valves





Here's wide range availability for both high and low pressure services from **W-K-M**.

For safe and positive high pressure control on christmas trees, flow wings, and flow lines, it's **W-K-M** Through-Conduit Gate Valves to handle working pressures from 500 to 15,000 psi.

For "expressway" turbulence-free flow in oil and gas pipelines, it's **W-K-M** ASA Through-Conduit Gate Valves from ASA 300 lbs. to ASA 1500 lbs.

For gathering lines, manifolds, headers and similar low pressure services, it's **acf** Lubricated Plug Valves—200 to 500 lbs. WOG.

You need dependability, performance, minimum maintenance! You need **W-K-M** and **acf** Valves, designed specifically to meet your requirements, in oilfield services, on pipelines, in refineries, in process and chemical plants, and wherever valves are required to control the flow of liquids or gases.

Complete your file of valve information by writing for these W-K-M Catalogs. Address Dept. A-603

W-K-M Catalog 200	W-K-M Through-Conduit Gate Valves for oil field services
W-K-M Catalog 300	W-K-M ASA Through-Conduit Gate Valves
W-K-M Catalog 400	ACF Lubricated Plug Valves
W-K-M Catalog 800	ACF Lubricant Manual

W-K-M

DIVISION OF **acf** INDUSTRIES INCORPORATED

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MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

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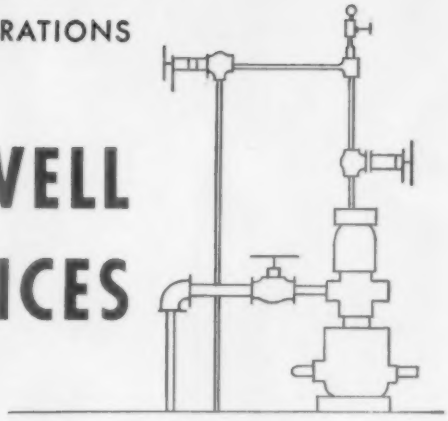
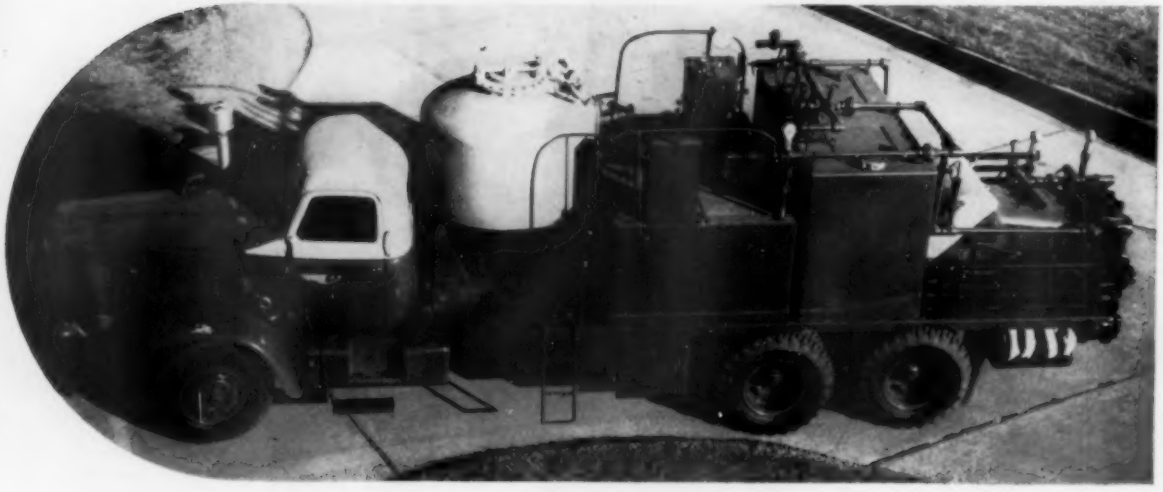
FOLLOW THE TREND TO LOW-COST OPERATIONS
WITH HALLIBURTON'S

PERMANENT WELL COMPLETION SERVICES





- **Squeeze Cementing**
- **Plug Cutting**
- **Collar Locating and Recording**
- **Perforating**
- **Sand Removal**
- **Placing Caustic, Acid or Corrosion Control Chemicals**
- **Gamma Ray Logging with collar counter**

To help oilmen take advantage of latest methods of cutting costs on completions and remedial treatments... Halliburton offers the best services on permanent-type well completions that modern research can develop... and the industry's most experienced field service organization can put into practice.

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HALLIBURTON
OIL WELL CEMENTING COMPANY
DUNCAN, OKLAHOMA

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FOR LOWER COST PERMANENT-TYPE WELL COMPLETIONS

TYPE "C"
PRODUCTION PACKER

HALLIBURTON'S TYPE "C" PRODUCTION PACKER with Latch-On Sealing Unit... a permanent-type drillable packer. Readily made adaptable to permanent-type well completions.

Large bore diameter accommodates tubing-type perforating gun, flush joint and coupled tubing. Unique Latch-On Sealing Unit reduces weight required to be set down on the packer and in many cases permits tubing to be placed in tension, also provides tight fluid or gas seal between packer and tubing string.

When the Type "C" Production Packer is set, the well can be treated as desired and placed on production. Effectively used in single- or dual-zone completions. Type "CL" Production Packer, similar in construction to Type "C", is designed to be run on and set by electrical wire line.

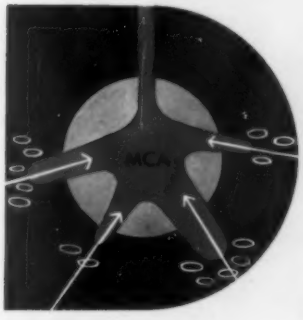
BULK CEMENT ADDITIVES

HOWCOGEL

Addition of "Howcogel", a high yield bentonite, to cement allows use of more mixing water per sack... forms Halliburton Gel-Cement. Increases slurry volume, lowers weight of cement column, reduces cement slurry cost. Used effectively with both common portland cement and retarded type cements.

HALLIBURTON HR-7

Dispersing agent and retarder for modified or high Gel-Cement. When used in permanent-type completion wells and agitated to a high rate of shear, high-gel cement slurry with HR-7 possesses low water loss characteristics and greater fluidity, making it very adaptable for squeeze work.

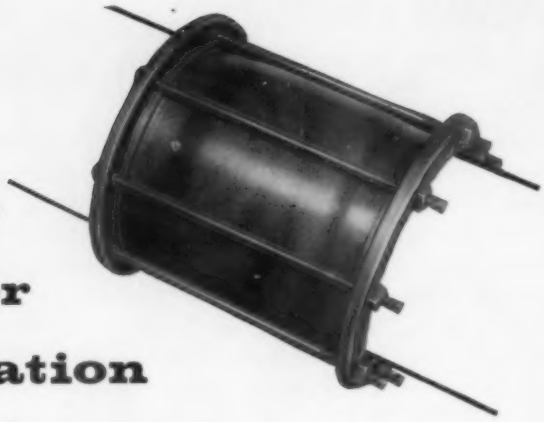


HALLIBURTON'S MCA (Mud Cleanout Agent)

Disperses mud, destroys water-oil emulsions and water blocks, shrinks bentonite for easy removal from well. Results in better cement bond to the formation when used ahead of either squeeze jobs or primary cementing of permanent-type completion wells, as well as regular completions. For use in wells completed with water-base or oil in water emulsion drilling fluid. Another cleanout solution is available for wells completed with oil base and invert muds.

CEMENTING SERVICES

251 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY WELL



for faster installation join pipe

THE DRESSER WAY!

You'll find plenty of uses for Dresser Couplings and Long Sleeves around a drilling rig . . . or anywhere else you join pipe.

That's because Dresser Long Sleeves make pipe joining so quick and easy. Pipe threading is eliminated. You simply slip on the sleeve and tighten with a wrench. Perfect alignment of pipe sections is unnecessary because the specially compounded rubber gasket permits up to 4° deflection at joints.

You get a permanent, bottle-tight connection every time—one that has the "give and take" necessary to absorb vibration, settlement and other stresses.

DRESSER®

Dresser Manufacturing Division • Bradford, Pa.

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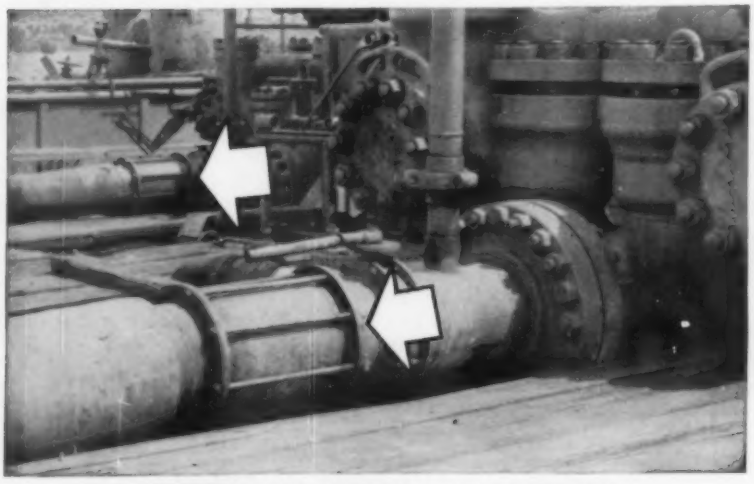

AVAILABLE AT ALL LEADING OILFIELD SUPPLY STORES IN THE UNITED STATES AND CANADA

Style 38 Coupling

Style 40 Long Sleeve

Hydrepair® Asbestos Cement Pipe Clamp

Style 63 Expansion Joint

Style 39 Insulating Coupling

ing basis which will eventually force him out of the gas business."

Arch H. Rowan, Fort Worth independent, in a statement at the Texas Independent Producers and Royalty Owners Association annual meeting, Galveston, Tex.

Russia in the Middle East

"As for Middle East oil, the Russian bloc, being a net exporter of oil and products, could not replace the present growing markets of the western oil companies. The governments of the oil producing states—Kuwait, Saudi Arabia Iraq, and Iran—are fully aware of this fact and would have no confidence in Russian ability to organize a comparable marketing group.

"The other Middle East states, including Egypt through the Suez Canal and, if the projected pipeline to Iraq is built, Turkey, all receive lesser returns from transit of oil and services to the oil companies. In general this return is not, in their view, enough to constitute, as is the case with the producing states, an overriding consideration."

George C. McGhee, former U. S. ambassador to Turkey, in a speech before the National Conference on the Middle East, Dallas.

Depletion importance grows

"With ever-increasing costs in searching and drilling for oil, we must continue or increase the 27½ per cent depletion recognition or we shall become dependent on foreign oil. This we must not allow to happen.

"Even if you discount war, once we become dependent on foreign oil the price of petroleum products will really go sky high . . . Even for our expanding economy we must encourage more and deeper drilling for oil by retaining the 27½ per cent depletion, or possibly increase it to 30 per cent. Depletion recognition is far more important today than it was in 1926 when established by Congress, or at any time in our history."

Lt. Gen. Ernest O. Thompson, Texas Railroad Commission, in a speech before the Texas Independent Producers and Royalty Owners Association.

Private investments abroad

"There can be no quarrel with nationalism as a legitimate expression of the aspirations and ideals of a free people. I am sure you will agree, however, that when nationalistic aspirations are misdirected and used by self-seeking politicians to gain the ends of personal power, a real threat to world peace exists.

"In my judgment, the most effective antidote to the growth of misguided

Larkin Forged Steel Swage

Nipples and Bull Plugs are

PRECISION FITTINGS

FROM START TO FINISH

There are 16 separate manufacturing and inspection operations that every Larkin Fitting undergoes before it leaves our plant. Beginning with the finest raw materials available, every step in the manufacturing process is designed to produce the finest precision fittings money can buy. After forging, Larkin Fittings receive careful descaling, threading, chamfering, beveling, coating, labeling and packaging. In between each operation is a step-by-step inspection. And there are no short-cuts. Specify Larkin through your supply store.

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WAXAHACHIE, TEXAS

LARKIN
...Through Your Supply Store

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Hexagonal Swages and Bull Plugs • External Upset Swages and Sub-Tubing Nipples • Refinery Swaged Nipples and Bull Plugs • Seamless Casing Nipples • Seamless Tubing Nipples • Steel Tubing Couplings • Substitute Couplings • Sub-Tubing Nipples and Pup Joints • Perforated Tubing Nipples • Adaptor Nipples • Boiler Nipples • Choke Nipples.

LARKIN LEADERSHIP HAS BEEN EARNED BY YEARS OF DEPENDABLE PERFORMANCE

Like the modern automobile with its power surge, every Weco Union has an extra measure of strength to take extraordinary service.

The best example of this is the use of Weco Unions in service company operations. Under high pressures and volumes, under shock, surge and vibration, Weco's ball and cone seat holds a seal that refuses to leak. The strong Acme threads in the female sub and wing nut make-up easily—break-out quickly—time and time again without damage or distortion. The tough wing nuts, sturdier sub ends with heavier wall construction, withstand the toughest treatment—on job after job—and come back for more.

This extra service from extra strength makes Weco the best union buy in the oil country today. Get them at supply stores everywhere.

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HOUSTON, TEXAS

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Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION

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nationalism is the development of the resources of nations on a private enterprise basis under conditions of free and open competition and maximum freedom for world trade. Nationalistic energies are by these healthful means channeled into production and exchange of goods with corresponding exchange of culture and ideas. Jobs are created and opportunities are provided for individuals to better their economic status . . .

"The maximum development of free trade is possible only through the operation of private capital and free enterprise. Government aid is only a beginning. It does not effectively generate capital for further recovery and expansion unless it is followed and amplified by private capital. Furthermore, government aid is on a government-to-government basis, and it unduly injects government into economic activities."

Stewart P. Coleman, vice president, Standard Oil Co. (N.J.), in a speech before the National Conference on the Middle East, Dallas.

U.S. companies in Canada

"Whatever decentralization has been achieved domestically must be extended substantially when doing business in Canada.

"Local management responsibility, local shareholder interest, and general identification with the community and national climate are not merely means of creating an enjoyable corporate reputation. On the contrary, allowing for differences in types of companies, these elements of decentralization in appropriate degree are essential to continued profitable operation."

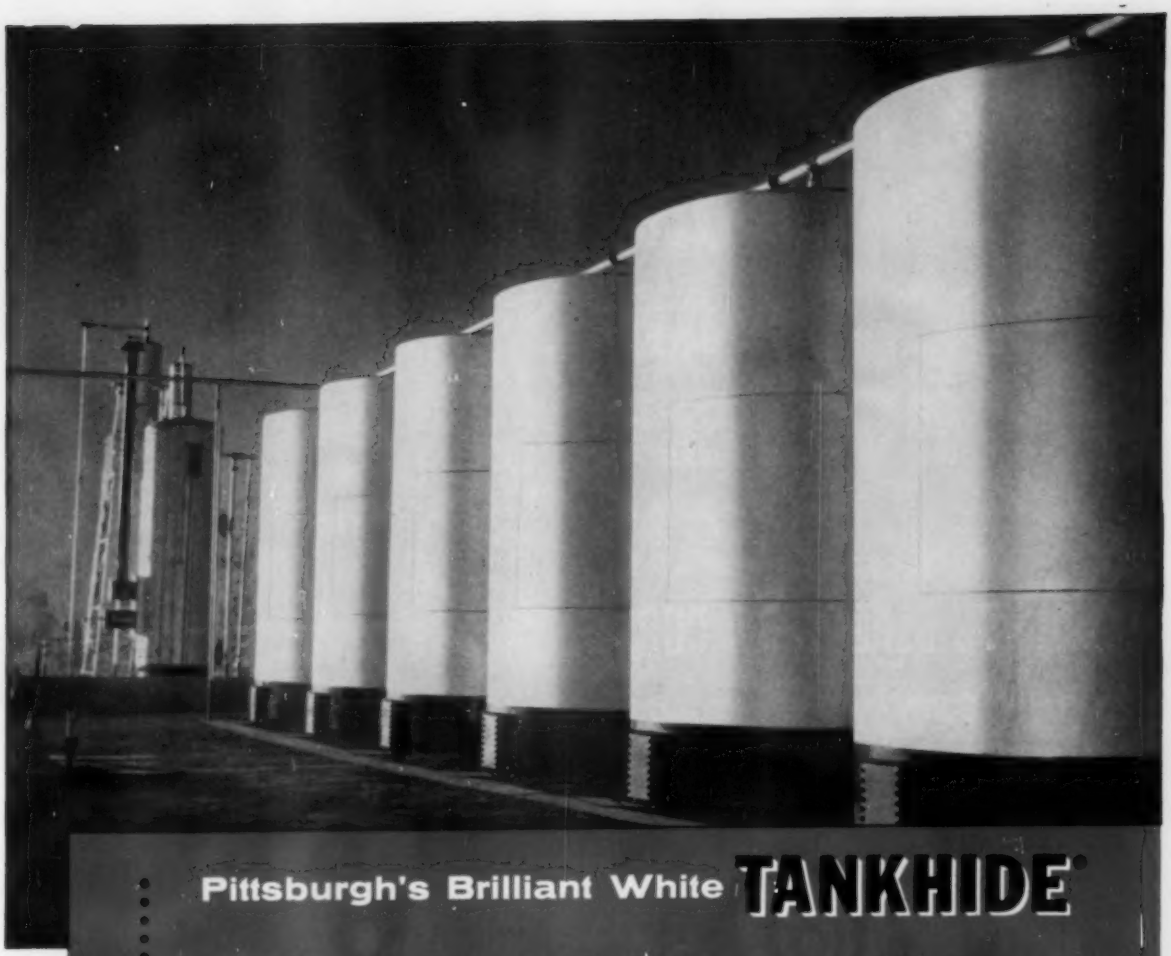
W. O. Twaits, executive vice president, Imperial Oil, Ltd., in a speech before the Comptrollers' Institute of America.

Creole's views on imports

"The company's position has been that oil imports into the United States are necessary to supplement domestic production . . . The sooner we produce the domestic reserves, the sooner we become too dependent on foreign sources. The welfare of the United States demands that we postpone that day as long as possible . . .

"On the other hand, it is necessary to keep the domestic industry in a healthy condition . . . This cannot be done if the country were 'flooded with imported oil.'

"We continue to hope that this problem can be solved by individual voluntary restraint on the part of the importing companies, instead of legislated controls which would deprive the in-



Pittsburgh's Brilliant White TANKHIDE®

Saves Money Two Important Ways . . .

1. **Special pigments and vehicles resist corrosion and weather**
2. **High heat and light reflection reduce waste by evaporation**

LOOKING FOR A TOUGH, long-lasting finish for gasoline and oil storage tanks that will save you money in two important ways? Then choose Pittsburgh's brilliant White TANKHIDE.

TANKHIDE is made with a combination of intensely white titanium pigments and weather-resistant vehicles to give a durable coating that withstands the destructive effects of weather and corrosion. It is designed for thorough one-coat hiding—can be brushed on when spraying is impractical. The quick set and firmness of its film during the drying period prevent collection of dirt and insects—hold damage from rain, scuffing and abrasion at a minimum. TANKHIDE'S gleaming whiteness is maintained throughout its long life by its self-cleaning action.

The ability of TANKHIDE to reflect light and heat holds loss of tank contents caused by evaporation to a minimum.

TANKHIDE is also available in synthetic gray and black as well as in gray and black oil-base finishes that are suitable for either metal or wood surfaces. Pittsburgh also provides a wide variety of high quality finishes for every need in the petroleum industry. Our wide experience in this field often can save you time and money. Write, wire or phone Pittsburgh Plate Glass Company, Industrial Paint Division, 1 Gateway Center, Pittsburgh, Pa.

PPG

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PITTSBURGH PLATE GLASS COMPANY

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PULL A VACUUM AND SWAB THE WELL CLEAN

with GUIBERSON GW CUPS

Save time.. save money.. save *fluid*.. with GW cups.. with Casing Swabs — products of Guiberson's more than a third century's experience serving the oil industry.

GW cups assembled on famous Guiberson Casing Swab

If you want to *swab* — not just agitate — flexible GW cups on the Guiberson Casing Swab will pull every drop. They hug the casing wall — provide automatic seal and controlled pipe contact — pull a vacuum and clean the well!

Precision molded in Guiberson's own rubber plant from special abrasion resistant compound, GW cups take up their own wear. They are unexcelled in rough or mixed casing strings and for unloading shallow wells. Won't down-swab or hang on casing collars. Interchangeable on the famous Guiberson Casing Swab.

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Sold by
Oil Field Supply Stores
Everywhere

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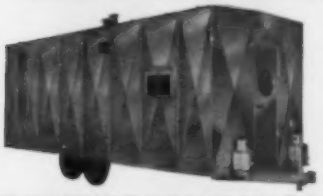
CAMPCARS



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CREW HOUSING
(1 to 50 MEN or more) anywhere!

Put your personnel on-the-job and keep them there at minimum cost. Self-containment features make it possible for men to live and work independent of utilities for long periods. Nine Standard Models—or interiors to your specifications. Designed expressly for industrial work and rough terrain use—not house-trailer construction.

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MORRISON RAILWAY SUPPLY CORP

Pioneer of Mobile Housing for Field Crews

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Centrally Located
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BUSINESS and PLEASURE
in TULSA means . . .

THE MAYO

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dustry of flexibility so essential to meet rapidly changing conditions and national and international emergencies . . .

"Liberal foreign trade is essential to accelerate the present rate of economic development in the free world. Major restrictive measures would reverse the trend toward more liberal trade and slow down the economic development which is so vital to our over-all national interest. Also, we should not forget that the U.S. is becoming increasingly dependent on strategic materials from outside her borders.

"Another aspect of this problem is that private foreign investments, particularly in Latin America, are needed to insure the more rapid economic development of the free world. Toward this end, greater incentives are needed, both here and abroad to encourage such private foreign investments."

H. W. Haight, president, Creole Petroleum Corp., in a statement to stockholders.

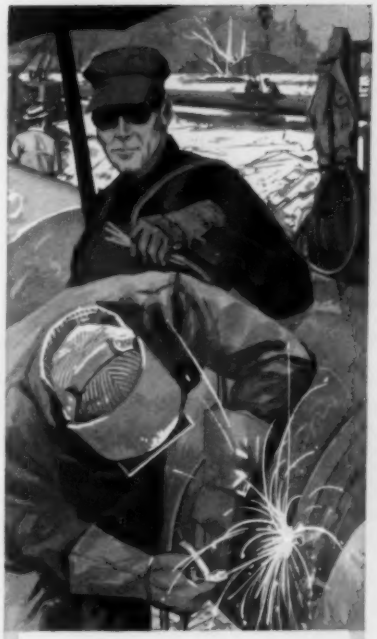
CALENDAR OF EVENTS

JUNE

4-6	Second annual Appalachian Underground Corrosion Short Course, West Virginia University, Morgantown, W. Va.
6	Pennsylvania Grade Crude Oil Association, thirty-fourth annual meeting, Penn-Sheraton Hotel, Pittsburgh.
9-14	American Society of Mechanical Engineers, semiannual meeting, Sheraton-Palace Hotel, San Francisco.
10-12	Interstate Oil Compact Commission, midyear meeting, Yellowstone National Park.
10-14	Gordon Research Conferences, petroleum, Colby Junior College, New London, N. H.
12-14	Engineering Institute of Canada, annual meeting, Banff, Alta.
16-21	American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.
17-21	Gordon Research Conferences, catalysis, Colby Junior College, New London, N. H.
18-19	Rocky Mountain Oil and Gas Association, annual meeting of refining committee, Northern Hotel, Billings, Mont.
19-21	Association for Computing Machinery, twelfth annual meeting, University of Houston, Houston.
20-21	Western Petroleum Refiners Association, Mid-Continent regional technical-industrial relations meeting, Broadview Hotel, Wichita.
20-22	National Oil Scouts and Landmen's Association, annual meeting, Hotel Cosmopolitan, Denver.
23-27	Canadian Gas Association, Jasper Park Lodge, Jasper, Alta.

JULY

8-19	Industrial Statistics for the Process Industries, second annual conference,



Sparks of plenty...

East of the Appalachians, there is much evidence of Transco's continuing development of good markets for natural gas. This provides a plentiful supply of gas for the Eastern seaboard. It also assures stable income for the producers of Texas and Louisiana — by taking their gas to the places where the most people are.

HELPING TO EXPAND THE MARKETS FOR TEXAS-LOUISIANA NATURAL GAS

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

You can make the finest lubricants when you

BLEND WITH ENJAY PARAMINS®*

*the *only* complete line of high-quality additives for fuels and lubricants.

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Pioneer in Petrochemicals

ENJAY COMPANY, INC., 15 W. 51st ST. NEW YORK 19, N. Y.

Akron, Boston, Chicago, Los Angeles, New Orleans, Tulsa

sponsored by American Society for Quality Control and the University of Oklahoma, Lockett Hotel, Norman, Okla.

AUGUST

26-28 Seventeenth annual Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

28-30 Instrument Society of America, International Symposium on gas chromatography, Kellogg Center, Michigan State University, East Lansing, Mich.

SEPTEMBER

3-5 Pacific Coast Gas Association convention, Fairmont and Mark Hopkins Hotels, San Francisco.

5-7 New Mexico Geological Society, eighth annual field conference, southwestern Colorado.

8-13 American Chemical Society, 132nd national meeting, New York City.

9-10 Independent Natural Gas Association of America, annual meeting, Shamrock Hilton Hotel, Houston.

11-13 National Petroleum Association, fifty-fifth annual meeting, Traymore Hotel, Atlantic City, N. J.

19-21 Rocky Mountain Oil Show, fairgrounds, Casper, Wyo.

22-25 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Mayo Hotel, Tulsa.

26-27 Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

26-27 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, Roosevelt Hotel, New Orleans.

30-Oct. 2 American Oil Chemists' Society, 1957 fall meeting, Netherland Plaza Hotel, Cincinnati.

OCTOBER

1-2 Texas Mid-Continent Oil and Gas Association, thirty-eighth annual meeting, Texas Hotel, Fort Worth.

2-4 Golden Trend Oil Show, Pauls Valley, Okla.

6-9 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, fall meeting, Adolphus, Baker, and Statler Hilton Hotels, Dallas.

7-9 American Gas Association, annual convention, Kiel Auditorium, St. Louis.

7-11 American Institute of Electrical Engineers, fall general meeting, Morrison Hotel, Chicago.

13-15 American Association of Oilwell Drilling Contractors, seventeenth annual meeting, Mayo Hotel, Tulsa.

13-19 OIL PROGRESS WEEK.

17-18 American Institute of Mining, Metallurgical, and Petroleum Engineers, Southern California petroleum section, fall meeting, Biltmore Hotel, Los Angeles.

17-19 Four Corners Geological Society, second field conference, Gallup, N. M.

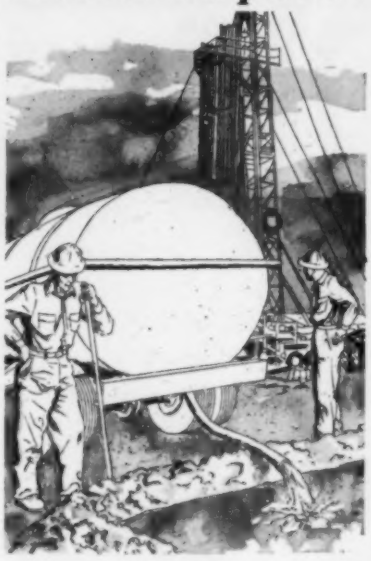
20-22 National Association of Oil Equipment Jobbers, annual convention and trade show, Hotel Peabody, Memphis.

24-25 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.

27-29 Independent Petroleum Association of America, annual membership meeting, Statler Hilton Hotel, Dallas.

31-Nov. 1 American Association of Petroleum Geologists, Mid-Continent regional meeting, Cimarron Ballroom, Tulsa.

Brine in the pit . . .



Like money in the bank

Super-saturated brine will save you hundreds of dollars in workovers, completions, and drilling through salt sections.

Brine is about one-third the cost of drilling muds. Drilling salt sections with brine guarantees a bit size hole, thus saving hundreds of dollars on cement jobs. So when you use Ready-Made brine it's almost like putting money in the bank.

Delivered directly to your location by tank truck, Ready-Made brine saves time and money in handling and, unlike field water, Ready-Made brine is crystal clear and pure. Free of suspended solids, brine will not hydrate or water-block bentonitic producing zones. It makes your completion much easier—much cheaper.

Call the ABI brine company nearest you. You'll get three hour service wherever you are. Also write or call an ABI company for information about brine's industrial uses.

COMPANY	PRODUCING POINTS
Brine Service Div., Corpus Christi Salt Co	Beaumont, Tex.; Pine Prairie, La.
Brine Service Co.	Houston, Corpus Christi
Toland Brine Service, Inc.	Kermit, Tex.
The Brine Co.	Midland, Tex.; Hobbs, N. M.

17 Years Old– Still Going Strong

After 17 years this Mission Plug Valve is ready for another long period of service

THIS MISSION PLUG VALVE bears the serial number 100. It was built in 1940 and for the past 17 years has served on the fill-up line of a blowout preventer on a South Louisiana rig.

It is shown here just before it was shipped back to the customer after being reconditioned by Mission. It again carries a new valve guarantee as do all Mission factory reconditioned valves.

Records show that it has been reworked only once during the last 17 years — a record seldom equalled by other types of valves.

Performance like this is not unusual for Mission Valves. Automatic Lubrication literally stops leaks before they start, preventing valve damage and increasing useful life. Because of their long life and freedom from maintenance, Mission Plug Valves are especially suitable for Christmas Trees, gathering systems, cycling plants and pressure maintenance plants.

Be sure to specify the name Mission the next time you order plug valves. They are available through supply stores everywhere.

Nothing but the finest will bear the name of MISSION MANUFACTURING CO.

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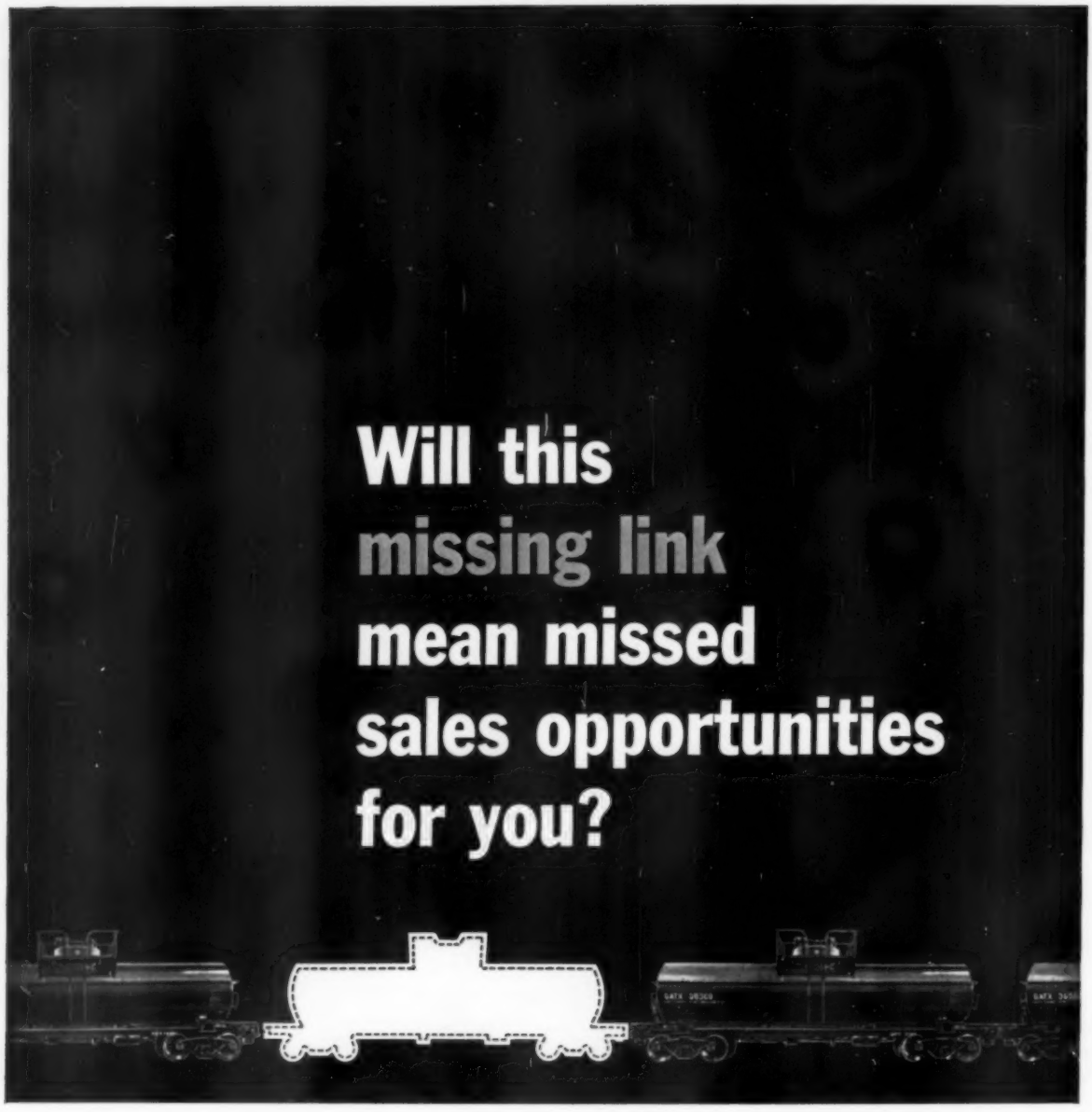

You'll want every general-purpose tank car you can lay your hands on in the decade ahead. Forecasts point to booming production and sales, and a vastly increased demand for shipping facilities. But normal obsolescence affects tank cars, too. A shortage of steel, plus the time required to build, will make for scarcity. That's why alert businessmen are already examining transportation requirements—planning for tomorrow's markets . . . today.

P. S. Plan now to discuss your long-range needs with our GATX District Man. You'll find . . . it pays to plan with General American.

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TULSA, OKLAHOMA

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JOURNALLY SPEAKING

About that Map

BEFORE WE GET an irate protest from the Williston Chamber of Commerce and cancellation notices from all subscribers in North Dakota, we hasten to admit that, yes, we pulled a booboo.

We have no intention of abolishing the great and sovereign State of North Dakota and annexing the Nesson anticline to South Dakota.

That little map on page 258 of our April 29 issue should have read "North," not "South."

The boner first came to our attention from an Oklahoma oil man who wrote:

"Not too many years ago the stealing of Sitting Bull's bones by some well-meaning people from my home town in South Dakota received national renown. Our neighbors to the north have never forgiven us that 'crime,' although the furor has died down. Your map will undoubtedly cause a renewal of the strife when North Dakota learns that South Dakota has 'appropriated' their oil fields as well. Although South Dakotans would be happy to have such oil fields, in the interest of civil harmony we'll settle for Sitting Bull's bones and let North Dakota keep the Williston basin."

We showed that letter to the boys in the exploration department and the art department, and the unanimous reaction was "not funny." Everybody was most contrite.

Who goofed? Nobody will 'fess up. It was just one of those things. One of those gremlins that swarm around every print shop at deadline time.

While we can't explain how this happened, the incident does give us a chance to explain that every map in the Big Yellow Book is drawn expressly for our own use by our own art department. We don't reproduce sections of other peoples' maps.

This is not so much out of respect for a copyright (what's an occasional copyright among friends?) as because they weren't drawn to show exactly what we want to show.

An awful lot of our editorial sweat goes into making the Journal easier to read. One of our devices for that is to give only the facts that are really essential for our readers, and cut out all extraneous material that might clutter up our articles or our artwork. That's especially true of our maps.

For instance, since you've already dug it out to laugh at our shame, examine that Williston basin map. If you can take your eyes off that error (which was so inconspicuous before we went to press and now sticks out like a sore thumb) you will note that the Outlook area has a white background while all the rest of the map is gray. The Outlook area is what the story is about, and we wanted you to be able to spot it quickly.

Everything else on that map is just to give you a place-fix—give you a general idea where Outlook is in relation to places with which you are familiar. Note that the map is not cluttered up with railroads, rivers, towns, county lines, and other topographical or geologic features which aren't important to the purpose, that is, fast reading.

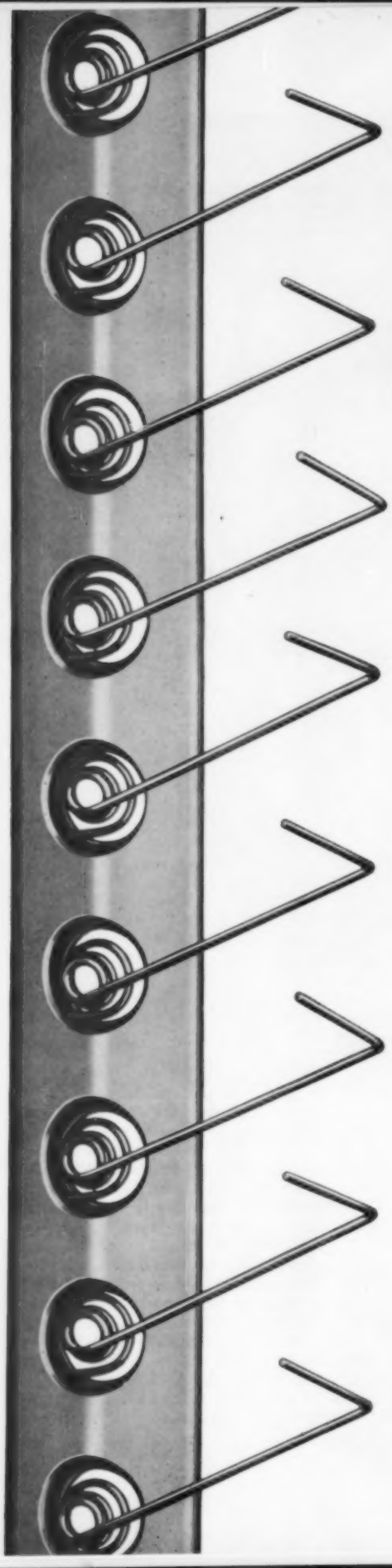
Now look at the map at the bottom of the same page. It has a somewhat different purpose. It's about Calvert-Tande, and see how those words stand out. In this case, township and section lines were important, so they are shown. The insert gives the location with respect to Tioga field, and the larger section gives well names and some geological contours. Here was a case where our readers needed this much detail, so we gave it to them. But to make it simple and direct, we left out details shown on other maps for other purposes.

Now you see what we mean by tailoring our maps to fit the needs of the story and the convenience of our readers?

You'll find that our maps are like that all through the book. And don't think that isn't a job. Each editor who wants a map has to give the art department a rough sketch or tracing with instruction as to just what he wants shown. The art department turns out these maps on a mass-production basis, picking up the dope from base maps on file plus the editor's notes.

So with dozens of maps like this being rushed out every week, a slip can happen. But it's a chance we take in our effort to make maps that tell the story quickly.

—*Henry D. Ralph.*



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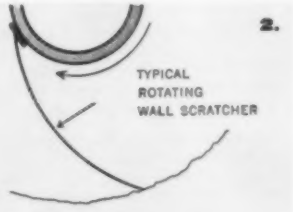

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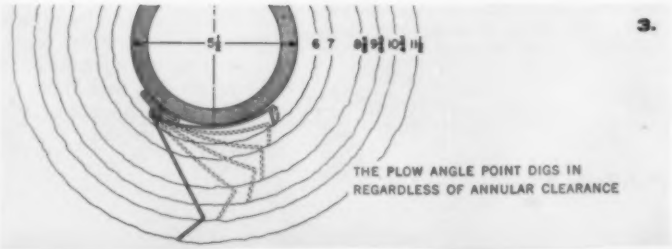

Inflexible market + expanded supply = same old trouble

TOO much again. That's the condition of oil supplies in this country today. The brief respite from depressing surpluses caused by the Suez closing has ended. The pendulum has swung back hard.

Unquestionably the industry is in for a tough summer. Drilling activity is down, allowables are being cut, purchaser proration is reappearing, and some crude finds no takers.

Crude stocks are still comfortable, but rising. Products stocks are unnecessarily large, and high refinery runs are returning. Products prices are soft, and distress material is not hard to find. The pressure of excess supplies means trouble for everybody from producer to retailer.

THIS IS NOTHING NEW. Periodically—and more often than not during its long history—the oil industry has got itself into similar jams by ignoring these fundamentals of petroleum economics:

- Demand is stable, steadily expanding, and easily forecastable to within a small margin of error.
- But the market is inflexible and can't be enlarged (short range) by promotions or bargain sales.
- So supply must be adjusted to demand if there is to be an approximation of the balance so essential to the stability of any industry.
- And the only practical way to control supply is in the form of crude oil.

To accomplish this the industry developed the principle of proration. It is legal, equitable, and practical. It has never worked perfectly, but it has prevented violent fluctuations in output and much of the time it has kept supply tolerably in line with demand.

The proration principle is still sound—sounder than ever. It says that flush production is entitled to a share of the market but not all of it, that old producers will move over and make some room but newcomers must not hog all the space. That's fair. It encourages orderly expansion and fosters conservation.

WHAT'S NEEDED NOW is to extend the proration principle to a bigger portion of current supply—that is, to imports.

Imports stand in the position of flush production. Some are needed now, more will be needed later. But the imports growth should be orderly. It should bear at least a rough relationship to market demand and permit survival of established producers.

The administration seems finally to have acknowledged this principle. But if it takes as long to devise a mechanism for applying it as it took the states and the industry to develop proration, the industry can look forward to years of depressing oversupply.

At best it will be months before the imbalance can be corrected. It will be a tough summer for everybody in the oil business.

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the OIL AND GAS JOURNAL

June 3, 1957

East Coast Will Get Another Refinery

● Commerce Oil is closing a custom-refining deal with Gulf that will permit construction of a 43,000-bbl. plant in Rhode Island. Gulf will supply crude for the plant and buy virtually all the refinery's products.

JAMESTOWN, R. I.—Barring unforeseen upsets, Commerce Oil Refining Corp. is now in a position to complete its long-drawn plans to build a 43,000-bbl. refinery in Rhode Island.

This project has been in the planning stage for well over 2 years *(The Oil and Gas Journal, May 30, 1955, page 56)*. But tight money, negotiations with numerous companies interested in processing contracts, local opposition, and other factors delayed plans well beyond the company's original expectations.

The new plant will be financed with the aid of Lehman Bros., New York investment brokers. Lummus Co., which has drawn up the processing plan, will build it. Universal Oil Products Co. will be the licensor of the seven conversion processes.

Three developments of recent weeks now point to success:

. . . Money for the plant is now committed, with a small amount already advanced for purchase of the site.

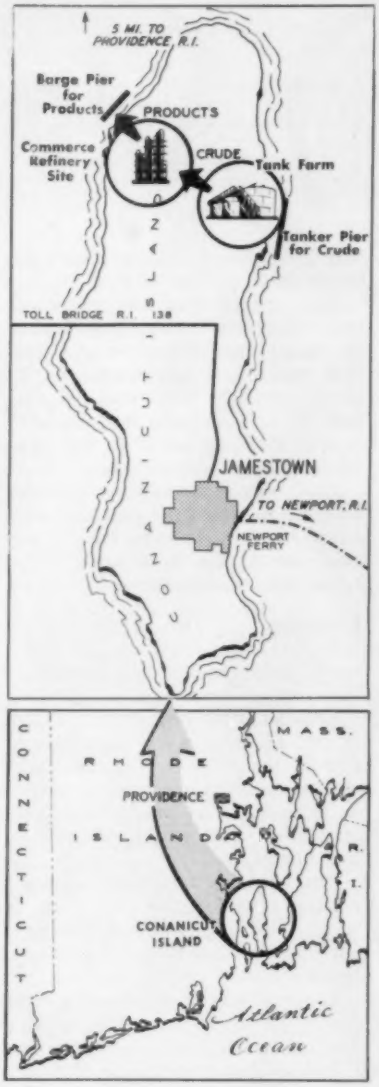
. . . Processing contracts on a custom-refining basis are now being signed with Gulf Oil Corp.

. . . Local and military permits are now in hand for building the refinery in the Narragansett Bay area (see map).

Throughout this long period of incubation, the site was shifted from Aquidneck Island north of Newport, to Conanicut Island, north of Jamestown.

The processing scheme has been altered many times, reflecting the trend in quality requirements and the availability of new techniques. Custom-refining plans were drawn up and discussed with a number of domestic and international oil companies.

What has emerged is a fuels plant with the latest processes for making a 100-plus octane pool gasoline, No. 2 fuel oil, a small yield of No. 6 fuel oil, coke, L.P.G., and sulfur. The refinery is designed to charge a 31°-gravity sour crude similar to West Texas or Kuwait.



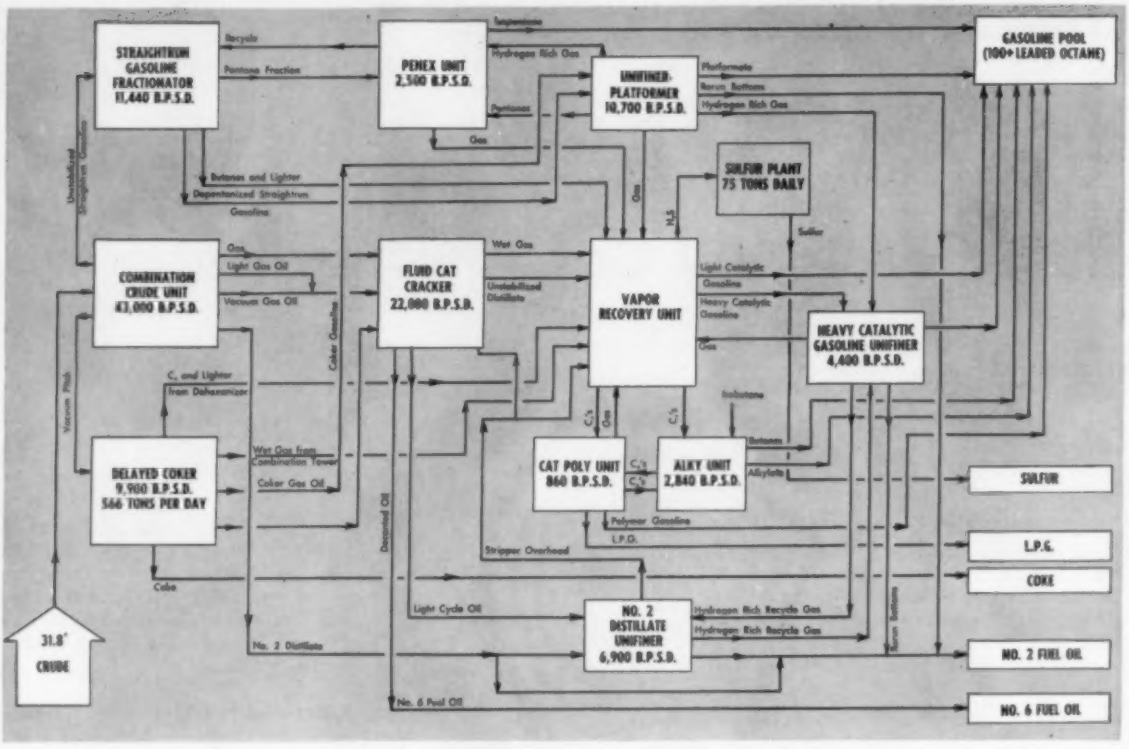
Gulf's deal . . . Gulf holds no interest in the company. But under a custom-refining arrangement similar to others in recent years, Gulf plans to sell Commerce crude and will buy virtually all products of the plant. A letter of intent has been given to Commerce, and within the past 2 weeks a contract stipulating crude and product prices has been submitted.

This arrangement will fit well into Gulf's marketing picture in the East. The new Laurel products pipeline, in which Gulf holds a 40 per cent interest, will divert some production at its Philadelphia refinery to western Pennsylvania and Ohio *(The Oil and Gas Journal, May 13, page 91)*. Commerce's output will provide makeup for Gulf's northeastern marketing area.

Commerce has had its problems getting the refinery firmed up. Over a period of 2 years, it approached or was approached by a number of companies including British Petroleum Co., Ltd., Petrofina, Getty Oil Co., Gulf, and other domestic oil companies. The possibility of custom refining for these companies on a crude-in, product-out basis was investigated. The outcome was the Gulf agreement covering all of the plant's crude and products.

Local problems . . . Local opposition to a refinery in a residential resort and Navy neighborhood caused more delay. But Rhode Island represents

How Commerce Will Make Products for Gulf



a relatively depressed business area today, with some 33,000 unemployed in the tiny state. With legislative backing, a governor's commission was set up to study ways to attract new industry.

From the first, the commission favored the Commerce project, in contrast to opposition from some local residents. While the state would have preferred to have Commerce locate in industrial areas nearer Providence, the lack of deepwater facilities ruled out such a compromise.

Finally, after prolonged discussions by representatives of Commerce, Lummus, and Gulf, with Navy, state, and local spokesmen, the present site was chosen.

Title has been taken on 300 acres of the 646-acre refinery site, and options are now being exercised on the remainder. The cost, exceeding $500,000, is being met by funds advanced by Lehman Bros.

Located near the north end of Conanicut Island, the plant will receive crude at a terminal on the east shore. A permit was obtained last week for a dock which will handle future supertankers of the 100,000-ton class. Water at the dock is 55 ft. deep.

The principals involved in this lengthy project are President Harry R. Lewis of Warren, Pa., and Treasurer and General Counsel Harold M. Geller of New York.

Now coming into the picture are two well-known oil men who recently retired from executive positions with major oil companies: E. E. Davis, formerly with Shell Oil Co., and Wm. R. Argyle, formerly with Sinclair Refining Co. Both will serve as directors of the company.

Also with Commerce is Malcolm T. McCants, formerly associated with Great Northern Oil Co. He will operate out of his Houston office as consultant and expediter.

Financing . . . One of the primary obstacles to buttoning up the Commerce plans was financing. This seems to be solved now.

Lehman Bros. will advance roughly half of the $64 million estimated cost of the refinery. The remainder will be raised by a debenture issue to be offered and underwritten by Lehman Bros. and others probably in late August.

The financing agreement contains a cushion extending the total funds to be provided to $71 million. But present plans indicate that this additional investment will not be required.

Lummus has been retained from the beginning to plan the refinery. The processing scheme has now been completed (see flow chart). Processes will be licensed from U.O.P. Lummus will perform the engineering and construction. Contracts are now being drawn up for licensing, design, engineering, and construction. U.O.P. will serve as the architect engineers.

Products . . . Eight catalytic conversion units will combine to produce a 60 per cent-plus yield of leaded gasoline with a pool octane rating exceeding 100 F-1. As shown in the schematic flow chart, the refinery will step out from the conventional with two new facilities—a superfractionation unit for light naphthas and a pentane isomerization unit.

Unifining will be widely employed to desulfurize catalytic gasoline, No. 2 fuel oil, and Platformer feed stock. Hydrogen sulfide will be separated and converted to elemental sulfur. Heavy vacuum pitch will be converted to thermal distillates and coke in a delayed coking unit.

Cost of the entire project will conform roughly to the projected yardstick of less than $1,500 per daily barrel of crude capacity. This rate has been mentioned recently for future refineries designed to make 100-plus pool gasoline.

Clearing and surveying are under way. No estimate of beginning of construction can yet be made, but completion is expected by late 1959.

New Bill May Emerge

Long House hearings expected to result in effort to get measure avoiding objections to present Harris-O'Hara bill

WASHINGTON.—A new gas bill, designed to sidestep objections to the Harris-O'Hara proposal, may emerge from the long hearings before the House commerce committee.

The dragging hearings will come to an end this week. Only members of Congress, for and against the bill, remain to be heard. Supporters and opponents have each had 2 weeks to submit their arguments.

After the hearings end, the committee will try to write a clean bill that can be sent to the House floor. How long that will take depends on the ability of Chairman Oren Harris to heal the split caused by administration demands for new provisions to "protect" consumers.

The administration wants the Federal Power Commission to consider cost in passing on producer rates. And it wants the FPC to review escalation clauses in existing contracts to see that increases do not exceed fair field price.

These raise the biggest problems for the committee. But this group also has a score of ideas that producers or consumers want put in the bill.

Trip to White House . . . Republican leaders have been to the White House in an effort to induce the administration to ease its demands.

But there appears little chance of a change in position, for political reasons if none other.

When the bill comes up for rewriting, committeemen who have supported it as the best compromise that can be passed will face opposition on several fronts.

Some members will be willing to go along if the administration changes are written in. Others will accept the bill on that basis if the use of costs is made mandatory rather than permissive.

A substantial group, however, is against any bill whatever. And still another group will press its own compromise in the shape of bills that would exempt small producers from FPC control but keep some 60 large producers under regulation.

Split in ranks . . . Witnesses before the committee last week disclosed that not all gas distributors are backing the bill.

Michael E. Shea, president of the Lynchburg (Va.) Gas Co., asserted that the measure will "seriously impair" the consumer protection now given by the Natural Gas Act.

The gas industry is getting along "very well" without the bill, Shea said. The growth of the industry indicates that a healthy situation exists.

"There are more consumers using natural gas, more natural gas being sold and more miles of pipeline in operation than at any time in the history of the industry," Shea testified.

"This expansion has every indication of continuing into the foreseeable future at near the same level as has been the experience of recent past."

Producers continued to cite the difficulties under present regulation as a reason why a new gas bill should be passed. Russell B. Brown, general counsel of the Independent Petroleum Association of America, pointed to a proposed change in FPC rules which would require producers to file detailed reports not only on gas sales but also on activities and operations entirely unrelated to the production and sale of gas.

The new rule "is an example of the intolerable situation resulting from the commission's attempt to control producers of natural gas as a public utility," Brown said. It could "only lead to increased cost to the producer which ultimately must be passed on to the consumer."

Objections to the rule have been filed with the FPC. The I.P.A.A. contends that it would go beyond the scope of the Natural Gas Act and would be illegal since it deals with matters outside the jurisdiction of the commission.

Anderson Named to Cabinet

WASHINGTON.—It's now official. Oil man Robert B. Anderson will be the next Secretary of the Treasury.

President Eisenhower last week nominated the 47-year-old former manager of the vast Waggoner estate to succeed Secretary George Humphrey. The popular Humphrey is retiring from the cabinet because of the illness and retirement of a business associate.

Anderson is now president of Ventures, Ltd., with headquarters in Toronto. The Canadian mining company has world-wide interests. Anderson joined the firm after a previous tour of government service.

The Texan was brought into government service by Eisenhower when he took office in 1953. His appointment as Secretary of Navy was made almost immediately after inauguration. Anderson served as Navy head until March 1954. He then transferred to the post of deputy Secretary of Defense and resigned from service in August 1955.

It has been known in Washington circles for some time that the President had Anderson in mind for another important spot either in Defense or Treasury. The official announcement last week confirmed reports concerning Anderson's replacement of Humphrey.

The shift . . . Humphrey has agreed to stay on until Congress adjourns.

This will give the new secretary a breathing spell before he has to wrestle with Congress over a new tax bill. One of the most controversial tax questions he will face, however, is the fight over the oil and gas industry's depletion allowance.

Anderson indicated last week in Toronto he will carry on the policies of his predecessor.

"During my service as Secretary of the Navy and deputy Secretary of Defense, I came in close contact with the plans and policies which have guided President Eisenhower and Secretary Humphrey in the conduct of Government's fiscal affairs," he said.

"These principles I expect to carry forward in the firm belief that wise fiscal policies are basic to the continued security and strength of our nation both economically and militarily."

A rapid rise . . . Anderson was born in Burleson, Tex., June 4, 1910, and has had a meteoric political and business career.

He served in the Texas Legislature and later became assistant attorney general of the state. In order, he served as state tax commissioner, a member of the state tax board, and chairman of the Texas Employment Commission.

He then became manager of the W. T. Waggoner estate in Texas which has big cattle, oil and land holdings after serving as its general attorney for several years. He is a past president of the Texas Mid-Continent Oil and Gas Association.

Record Miscible-Phase Project Planned

● Magnolia says a propane-chased-by-gas program in Parks field of West Texas will boost ultimate recovery by 100 to 150 per cent of primary recovery.

AUSTIN.—Magnolia Petroleum Co. revealed plans here last week to spend a whopping $3,500,000 to carry out the biggest miscible-phase displacement project yet.

The company asked the Texas Railroad Commission May 28 for a permit to launch the program immediately in big Parks Pennsylvanian pool in Midland County, West Texas (see map).

The project will involve all of the Parks unit's 8,160 acres. It may be extended later to include about another 2,000 acres reasonably proved but undeveloped and not now in the unit.

The unit will use a propane slug chased by gas, one of three variations of the red-hot miscible displacement principle *(The Oil and Gas Journal, March 11, page 96).*

All told, it will inject a staggering 1,500,000 bbl. or more of propane within 9 months to a year after start of injection. Daily input rate will range from 4,000 to 8,000 bbl. through the total 25 proposed input wells.

Magnolia, as unit operator, plans to follow the propane with a gas sweep through the same inputs. About 16,000,000 cu. ft. of gas daily will be needed for this purpose.

Contracts for the propane and the gas reportedly have already been signed. And engineering is near completion on a field-wide system of high-pressure lines to distribute propane to input wells.

The propane is expected to come from the big Magnolia-operated Pegasus gasoline plant to the south, and from certain plants in the Spraberry Trend Area field. The plan involves laying a pipeline from Pegasus to deliver the L.P.G. to Parks and possibly another to the field from Spraberry.

Big payoff . . . Magnolia told the commission it expects to hike oil recovery from Parks via the program by 100 to 150 per cent of primary production.

Primary from the 10,400-ft. Bend section of the Pennsylvanian has been estimated by Magnolia at about 15,000,000 bbl.

The miscible drive thus would kick

up total ultimate oil take to between 30,000,000 and 40,000,000 bbl.

This is a pretty big dividend.

Other evidence that the unit thinks highly of the program's possibilities is that it is going the miscible route rather than expand what has proved to be a highly satisfactory pilot water flood already in operation.

Magnolia engineers told the commission the unit expects the propane-gas drive to recover substantial oil over and above what a field-wide water flood would net.

Young but weakening . . . Parks is a young field as oil fields go. But it's promising to become senile early.

It is a large anticlinal feature with a fault cutting across the field from northwest to southeast.

Magnolia drilled the field discovery in December 1950 and is the biggest operator in the field, with a working interest in the unit exceeding 90 per cent.

The field so far has produced, as of April 1, 3,362,820 bbl. of oil, 19,063,031 M.c.f. of gas, and a negligible amount of water. The discovery came in with a gas-oil ratio of 1,770:1. Bottom-hole pressure was 4,567 psi.

Pressure had fallen by last January to 1,710 psi. and the G.O.R. had climbed to a field-wide average of 6,250:1. Burdened with such a high G.O.R., the Parks wells have had production cut sharply under ratio penalties enforced by the commission.

The field reached its highest production in September 1952 when 29 wells produced an average of 2,662 bbl. of oil and 11,044 M.c.f. of gas a day. Last March, 55 producing wells were able to make only 985 bbl. of oil a day and 9,537 M.c.f. of gas.

It became obvious early in the game that Parks was a solution gas-drive pool, producing without aid of either a water or gas-cap drive. Operators soon realized something would have to be done in the next few years to bolster the drive before it was too late.

Development because of this has proceeded slowly. At present, only about 4,720 acres is considered developed. Another 5,280 is labeled "reasonably proved but undeveloped." There's room for a total of about 125 wells with the field's 80-acre spacing pattern.

Water pilot started . . . The Parks unit was approved in July 1954. And the present pilot water flood was launched the following February.

More than 1,639,000 bbl. of water has been injected (to April 1 this year) through four input wells in a five-spot on the west side of the unit. The four wells now are taking about 2,500 bbl. of water daily.

The allowable of the center producing well in the five-spot has increased 377 per cent from 58 to 210 bbl. daily; the G.O.R. cut from 7,910:1 to only 1,336:1; and pressure boosted from 2,159 to 2,974 psi.

Results in a 10-well observation area, though not so spectacular, have nevertheless been good. And there is no sign of premature water breakthrough.

One drawback to expanding the pilot has been a lack of water. Present capacity of the unit's present water source in the San Andres formation is only 2,900 bbl. daily.

Magnolia recently acquired a big supply of water in an option to purchase the sewage effluent of the city of Midland, a few miles to the north *(The Oil and Gas Journal, May 20, page 125).* The plan initially was to use this water, if it could be treated and transported economically, for full-scale floods in the Parks and Pegasus pools.

Pegasus still figures in this plan, but Parks will no longer need the water.

Some answers coming . . . The big Parks project should go a long way in helping settle arguments as to whether the propane-slug technique is economically sound.

It would be the largest of the miscible-phase displacement projects yet

attempted, and the only large, field-wide application of the propane-slug principle.

The only other field-wide programs in operation in sizable pools employ different methods to achieve the miscible drive.

Atlantic Refining Co. uses its high-pressure gas-injection version in Block 31 Devonian field in Crane County, West Texas. It is injecting about 37,000,000 cu. ft. of gas daily through 15 input wells at a wellhead pressure of over 4,000 psi. The unitized project area takes in more than 6,000 acres.

Humble Oil & Refining Co. is under way with its condensing gas-drive method in the Goen and Cambrian reservoirs of Bronte field in Coke County, West Texas, and in the 20-B pay of Seeligson field in South Texas.

The Goen pay in Bronte takes in about 1,300 acres and the Cambrian about 460 acres.

Humble's approach involves injecting rich casinghead gas or mixing propane and separator gas to effect a miscible drive.

Approval likely . . . Magnolia's proposal for Parks is pretty certain to get commission approval.

The company is not asking for unusually high allowables to compensate for the extra cost of injecting L.P.G. The proposed new field rules generally would set up a net gas-oil ratio and provide for allowable transfers. These have come to be a fairly standard request for new pressure-maintenance projects in Texas and usually are approved.

Then, too, the commission has a past history of backing where possible any experiment or test which may cut down the amount of oil left behind.

Prospects are that the permit will come through soon. Magnolia urged the commission to act speedily, otherwise field pressure might drop too low to insure miscibility.

West Texas Holdings Sold

HOUSTON. — Cecil Oil Corp., Houston, has sold two producing oil leases in West Texas for $2,500,000 cash.

Purchasers include Fred Fox & Associates, Dallas, and Stekoll Petroleum Co., also of Dallas. Stekoll will operate the properties for the purchasers.

The transaction involved two leases totaling 1,380 acres in Justiceburg-Glorietta and Dorward fields, Garza County. U. M. Harrison, Cecil Oil president, said the leases are now producing about 40,000 bbl. of oil per month.

Oil Spokesmen Needed

● Journal publisher says industry can lick "bad press," erase prejudices by selling oil at home, in Washington

DENVER.—The oil industry's sick public relations needs two stimulants: A bold information spokesman in Washington and the help of everyone in the industry working for better understanding with their home-town friends.

A better understanding of the industry by the public is more than oil's No. 1 problem. It may mean "survival of the industry as we know it and want it to continue."

These observations were made last week by P. C. Lauinger, president of The Oil and Gas Journal, in an address before the Rocky Mountain Oil and Gas Association.

The problem . . . The biggest danger facing the oil industry, according to Lauinger, is what the Government might do through unwise legislation.

"Not many people in either federal or state government really want to destroy the oil industry," he said. "But they think it needs some improvements. They think it is not operating to the best interests of society as a whole.

"So every time that Congress or a state legislature meets, there are proposals to improve the industry. They may be well-intentioned, but most of them would amputate, dismember, or cripple the industry so that it wouldn't function at all.

"And where do the legislators get these drastic and often screwy ideas? Why, from the public. They seldom think them up themselves. The reason we have screwy legislation is not that we have screwy legislators. We have it because the public has screwy ideas about the oil industry."

That means the problem is this: To get good government relations, first get good public relations. Intense lobbying during one session may kill one undesirable bill. But the same old proposals—and worse new ones—will keep popping up as long as the public thinks the oil industry needs working over.

What's being done . . . People don't understand the oil industry "because we haven't explained ourselves to them," Lauinger declared.

He observed that during the last 10 years the oil industry has spent something like $30 million on a formal public-relations program. Under the elaborate setup reams of pamphlets, booklets, press releases, pictures, and cartoons have been issued. Movies, speeches, books, and programs of all kinds have been dreamed up by publicity experts.

"But these things haven't got the job done," the publisher said. "Things might be worse now if we hadn't done all this, but we haven't erased the public's prejudice against the oil industry, haven't got it out of the frame of mind of thinking the worst about us."

Lauinger said the key to this failure lies in one fact: Oil men are leaving public relations to the experts and not helping with the job personally. "If people really knew what makes the oil industry tick, they wouldn't be so critical of it and wouldn't be so eager to reform it," he said.

His advice to every oil man: "Get acquainted with the public and get the public acquainted with you. Find out what people really think of you —and what makes them think that.

"Try to convince them that most of the bad things said about you aren't true, and try to make them see you—the oil industry—as you really are. This takes work, individual work on the part of every oil man working with every segment of the public he comes in contact with—whether it's a big-shot molder of public opinion, a taxi driver, a barber, or whatever."

Lauinger explained further: "When you come right down to it, public relations means having friends. There's no magic formula for that, and there's no magic formula for an industry to get on friendly terms with the public."

The press . . . Lauinger chided the oil men for complaining that newspapers get their oil stories all balled up or that editors get the wrong slants in their editorials.

"But I can hardly name a single oil man who does anything to correct it," he said.

The oil business is often a technical affair, unfamiliar to reporters and editors. But what happens when a reporter from the local newspaper comes around on an oil story? "If you're like most oil men," Lauinger said, "you run away as fast as you can. Or say, 'no comment.' Or you refer him to the company public-relations man and then tell the public-

relations man not to tell him anything."

The publisher advised oil men to take particular pains to see that every newsman gets the facts on a story, gets a clear picture of the oil industry, and knows the answers to criticisms which arise. The answer is for each oil man to cultivate the reporters and editors of his home-town newspaper.

"You have to do that yourselves—right at home. For right at home is where the industry's public-relations problem is and where it will always be. If you can get all the people individually to think well of the industry, the mysterious 'bad public opinion' will evaporate."

A spokesman . . . Washington is the news and opinion center of the world and most of the things said there about the oil industry are unfavorable, Lauinger said.

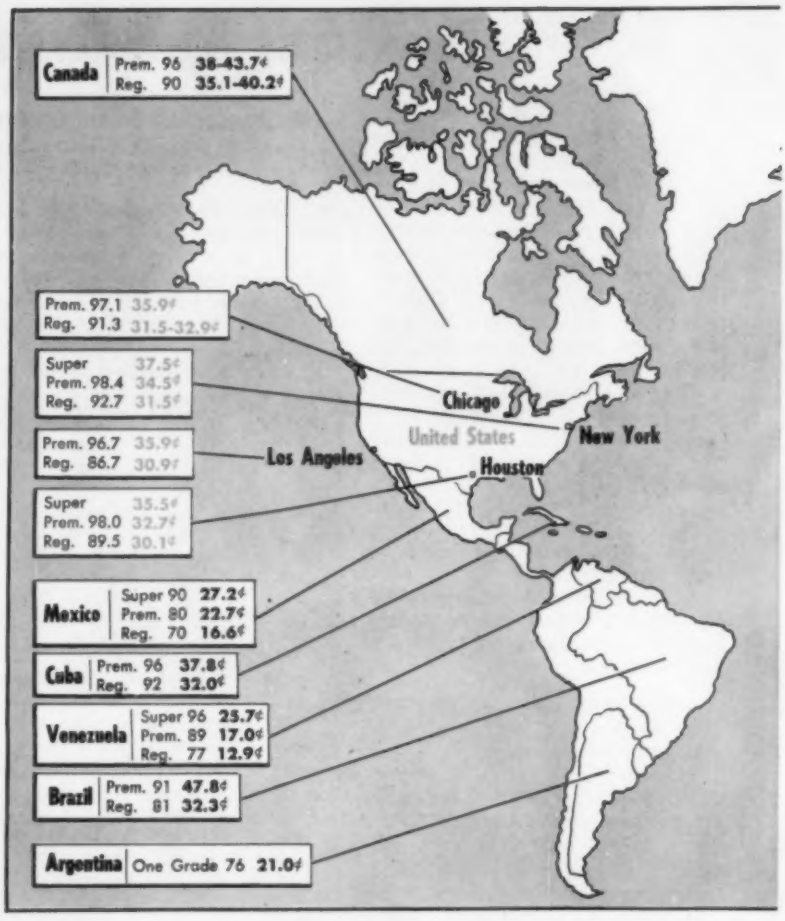
The explanation is simply this: There's nobody in Washington saying favorable things. The industry has no Washington spokesman, though that's the most important place in the world for it to have a spokesman, he explained.

The industry does have lobbyists and representatives of trade associations in the nation's capital. None of them, however, speaks for more than a segment of the industry.

Lauinger said an oil spokesman should not be a lobbyist or a propagandist. He should have a very small research staff capable of answering any questions about the industry. But he shouldn't wait for the questions to be asked. He should anticipate the questions and get the answers out in advance. And he should be capable of acting promptly at any hour of the day or night.

The Washington spokesman would be an information bureau and a mouthpiece for every segment of the industry, but a tool of none. Each segment of the industry can do its own special pleading, its own lobbying, and its own public-relations work, and can fight with the others as it sees fit.

The spokesman, according to Lauinger, should be above all that. His job is to put out information about oil in the world center of information. A right sort of information bureau in Washington would go a long way toward keeping both government officials and the nation's press corps from going so far off the beam on matters of oil. It would go far in overcoming the industry's "bad press"—and do it in a way that the newspapermen themselves would welcome and appreciate.



Motorists in the U. S. Get

AMERICANS may think they pay a high price for gasoline.

But until they "fill 'er up" in a few foreign countries they haven't seen a thing. Quality can be surprisingly good. But taxes and import duties send retail prices to a level that would make a U. S. oil man wince.

Premium in Italy sells for 92.1 cents per gallon. This is the highest-priced gasoline in the world today. Regular in the same country sells for 86 cents.

Some higher prices are listed by the U. S. Bureau of Mines, but these are based on official currency exchange rates in countries where such rates are largely ignored. In Rio de Janeiro, for example, the price for premium is $1 68 a gallon on paper. Americans actually buy it there for about 48 cents a gallon, however.

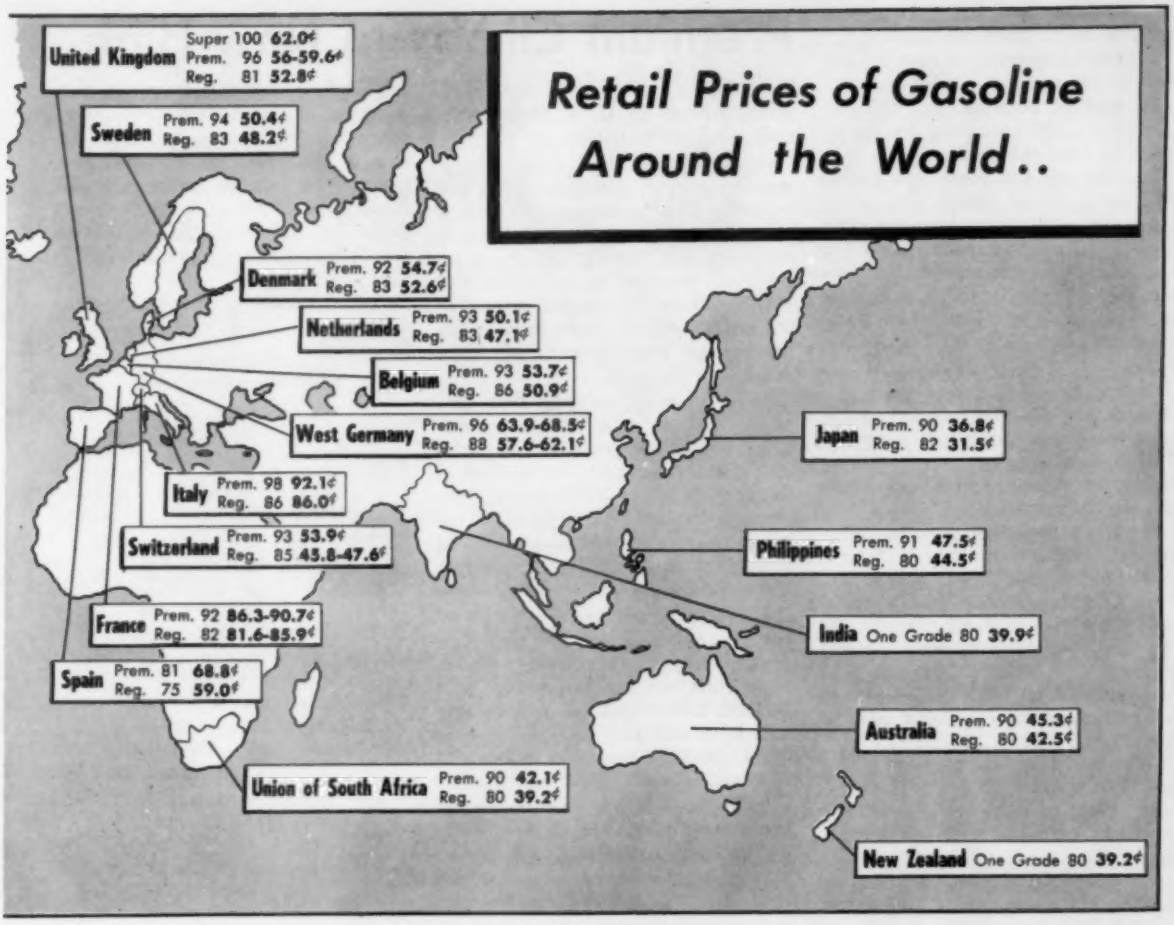
Despite a general drop of 1 to 2 cents a gallon in Europe since the reopening of the Suez Canal, premium in countries outside Italy ranges from 53 to 91 cents a gallon. Even with a temporary 12-cent tax per gallon in the United Kingdom removed, regular costs 52.8 cents, premium to 62 cents.

These and other prices (see map) are in U. S. cents and U. S. gallons, converted from local currencies and measures. They were recorded in U. S. Bureau of Mines surveys or obtained from the industry.

The general high prices are a reminder that in most of the world, motoring is a luxury and gasoline is a luxury product. What's more, taxes and duties are designed to keep the situation that way.

In the United Kingdom, the world's second largest gasoline-consuming country, duty comes to about 30 cents per gallon. Duties and taxes in Belgium are 29.8 cents a gallon; West Germany, 27.5 cents; Switzerland, 22.0 cents; Netherlands, 25.6 cents; and Brazil, 22.4 cents.

Quality comes high . . . One method of comparing gasoline prices is price


Retail Prices of Gasoline Around the World..
United Kingdom Super 100 62.0¢ Prem. 96 56-59.6¢ Reg. 81 52.8¢
Sweden Prem. 94 50.4¢ Reg. 83 48.2¢
Denmark Prem. 92 54.7¢ Reg. 83 52.6¢
Netherlands Prem. 93 50.1¢ Reg. 83 47.1¢
Belgium Prem. 93 53.7¢ Reg. 86 50.9¢
West Germany Prem. 96 63.9-68.5¢ Reg. 88 57.6-62.1¢
Italy Prem. 98 92.1¢ Reg. 86 86.0¢
Switzerland Prem. 93 53.9¢ Reg. 85 45.8-47.6¢
France Prem. 92 86.3-90.7¢ Reg. 82 81.6-85.9¢
Spain Prem. 81 68.8¢ Reg. 75 59.0¢
Union of South Africa Prem. 90 42.1¢ Reg. 80 39.2¢
Japan Prem. 90 36.8¢ Reg. 82 31.5¢
Philippines Prem. 91 47.5¢ Reg. 80 44.5¢
India One Grade 80 39.9¢
Australia Prem. 90 45.3¢ Reg. 80 42.5¢
New Zealand One Grade 80 39.2¢

the Most for Their Money in Gasoline

per octane per barrel. This shows the cost to the motorist and just how he pays for quality in foreign countries.

Take two gasolines, for example, both selling for 35 cents per gallon. One has a research octane number of 85 and the other 95. Obviously, the 95 R.O.N. is a better buy because the motorist gets more quality for his money.

With both selling for 35 cents per gallon, both would retail at $14.70 per barrel. By dividing the price by the octane number, you come up with the price per octane per barrel. For the 85 octane, the price per octane per barrel would be 17.3 cents and for the 95 octane it drops to 15.5 cents.

This weighting of quality with price gives a better comparison of the value of the gasolines than price alone.

In the U. S., 97 octane premium retailing at 31.5 cents would be about 13.6 cents per octane per gallon. Regular 91 selling at 28 cents would be 12.9 cents.

In contrast, the price per octane per barrel for premium in Britain is about 25.4 cents. In France it's 41 cents; West Germany, 29 cents; and Spain, 35.7 cents.

Around the rim of the Indian Ocean, regular 80 octane, sometimes the only grade available, sells for about 40 cents per gallon, or 21 cents per octane per barrel.

Japan stacks up pretty well. Its price per octane per barrel is about 17.2 cents.

In countries where government controls hold down prices, gasoline isn't always too much of a bargain considering quality.

Venezuela's 77 regular, on which marketers lose money, retails for 12.9 cents per gallon, or 7 cents per octane barrel. Mexico's 70 octane regular at 16.6 cents per gallon costs users 10 cents per octane barrel. Argentina's single grade 76 octane at 24 cents costs 13.3 cents per octane barrel.

Responsibility for low octanes in many countries can be blamed directly on government price controls. These not only stifle incentive to improve product quality, but in some cases make it literally impossible to boost octanes and remain in business.

Distribution costs in many countries are high to begin with and when price controls are laid down they slice profit margins thin. This makes it economically impossible to invest new money to raise quality.

High prices on foreign gasoline, especially in Europe, are a definite lid on sales. Fuel and diesel-oil demand would undoubtedly outgain gasoline in spite of cost. But high gasoline prices add to the certainty that refiners will have a smaller market for their most profitable product.

Figures recently compiled by the British Petroleum Industry Bureau for 1956 show how much gasoline's relative position is slipping. These United Kingdom figures are more or less typical for most of Europe:

... **Gasoline sales rose** 1.3 per cent last year to 153,000 bbl. daily.

... **Total consumption rose** 8.5 per cent to 505,000 bbl. daily.

... **Fuel-oil demand rose** 20.2 per cent to 121,000 bbl. daily despite restrictions after the Suez crisis.

... **Gas oils and diesel oils** gained 10.5 per cent to 50,000 bbl. daily.

Gasoline sales to truckers and other commercial users actually declined 5 per cent. This same group of users was largely responsible for a gain of 12.3 per cent in "Derv," the local name for fuel for diesel-engined vehicles.

Octanes are climbing . . . Octanes in most free-world areas are going up. This is due largely to refiners competing for gallonage in the comparative shrinking market.

Premium 98-octane gasoline delivered to motorists in Italy is 5 to 8 points higher than it was a year ago. This gain was unquestionably affected by the fact that the country has the most over-built refining capacity in Europe. A decline in export sales last year also stirred local refiners to hang on to or increase local sales by improving quality.

West Germany had gains of 3 to 5 points in premium and 1 to 3 in regular in the same period. French regular and premium were up 1 to 2 points. Regular in the U.K. gained up to 3 octanes and premium was up 1. The U.K. also added 100-octane.

At least three countries added premium as a second grade. They were Union of South Africa, Cuba, and Philippines.

Refiners abroad are taking the lead in raising octanes. Automobile makers are increasing compression ratios to take advantage of it.

U. S. refiners with new super and stepped-up premium are now ahead of engine requirements. But until recently the industry was hard-pressed raising octanes to match higher compression ratios.

Traditionally, European cars have had low horsepower and low compression ratios. A few hot makes do require the best gasoline, however.

Tests on a dozen British models by one oil company indicated present cars react well to higher octanes when spark timing is adjusted. Power increased more than 10 per cent when octanes were boosted from 76 to 91. There also was a fuel saving of nearly 5 per cent.

British motorists apparently are impressed by premium grades. Premium now accounts for more than half of all British gasoline sales. It gained 3.7 per cent last year, against a decline of 1.1 per cent in regular grades.

Premium Climbs to New High

IN A BURST of quality competition, octane ratings in U. S. motor fuels took a big jump in May.

According to Ethyl Corp.'s latest monthly survey, premium grade, not including third grade premium, moved to a weighted average of 98.0 research octane, a new record. At the same time, regular grade moved up to 90.8 R.O.N. These represented jumps of 0.3 and 0.2 R.O.N., more than double the average monthly trend in recent years.

Ethyl's survey weights only premium samples sold in the conventional two-grade system and the middle grades marketed by companies selling three grades. Thus, the weighted averages reported do not show the whole picture on octanes available throughout the country. The survey covered 57 cities.

Research octane averages of 99 or better showed up for the first time among conventional premium grades. Four cities were in this group, with Newark and Baltimore topping the list. Both had 99.1 averages. Boston and Little Rock were next in line with 99.0 averages.

Average premium-octane ratings of better than 97 R.O.N. showed up in 47 cities. Salt Lake City had the lowest average on the survey because of the high-altitude factor. Its rating was 94.3 R.O.N.

A new breakthrough on city averages also occurred in regular grade. Two cities, New York and Hartford, averaged 93.0 R.O.N. for the first time. Salt Lake City again chalked up the lowest average, with regular grade running 83.6 R.O.N.

The presence of nine premium samples of above 100 octane indicates that some two-grade manufacturers are making their premiums competitive with third grades. Two samples of 100-plus octane were found in Newark, New York, and Baltimore. One was found in Philadelphia, Pittsburgh, and Boston.

Thirty-six third-grade samples were picked up in May in 18 cities contrasted to 27 in 15 cities in April. In April the samples ranged from 100.0 to 101.6 and in May from 100.3 to 101.8.

The fact that most premium brands are closing in on 100 octane became increasingly apparent last month. Of the 481 samples of premium tested by Ethyl, 86 were between 99.0 and 99.9 and 142 were in the 98.0-98.9 range. The 228 samples of 97 octane and up represented almost 50 per cent of all premium samples taken.

The most pronounced change took place on the West Coast where premium has gone up sharply since the first of the year. In the five West Coast cities included in the poll, premium went up 0.9 octane in San Francisco and Bakersfield, 0.8 octane in Los Angeles, and 1.0 octane in Portland and Seattle.

A breakdown of the May survey follows:

PREMIUM
(Cities per octane group)

Group—	May 1957	April 1957	May 1956
90-90.9	0	0	0
91-91.9	0	0	0
92-92.9	0	0	2
93-93.9	0	0	0
94-94.9	2	3	5
95-95.9	1	1	10
96-96.9	7	14	18
97-97.9	18	13	20
98-98.9	25	26	1
99-99.9	4	0	0
Total cities	57	57	56
Weighted avg. R.O.N.	98.0	97.7	96.7
Weighted avg. TEL, ml./gal.	2.60	2.53	2.56

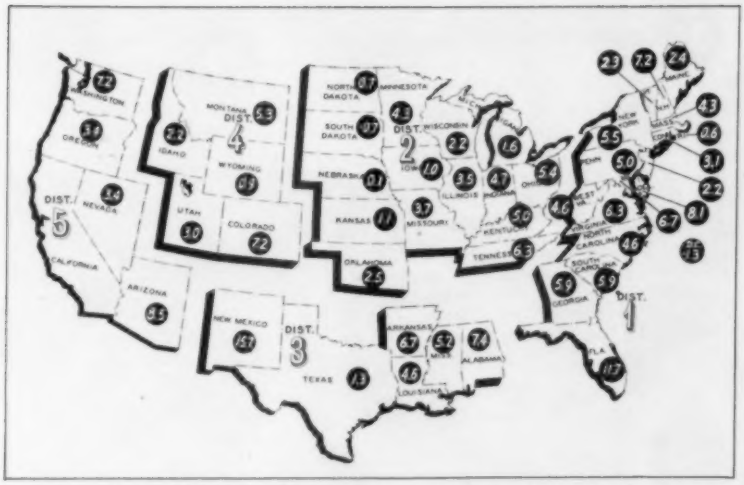
REGULAR
(Cities per octane group)

Group—	May 1957	April 1957	May 1956
81-81.9	0	0	1
82-82.9	0	0	0
83-83.9	1	1	0
84-84.9	0	0	1
85-85.9	0	1	2
86-86.9	1	3	12
87-87.9	4	5	8
88-88.9	15	12	3
89-89.9	13	13	13
90-90.9	3	2	1
91-91.9	8	9	12
92-92.9	10	11	4
93-93.9	2	0	0
Total cities	57	57	57
Weighted avg. R.O.N.	90.8	90.6	89.7
Weighted avg. TEL, ml./gal.	2.14	2.03	2.30

Offshore Lease Sale Set

MONTGOMERY, Ala.—The Alabama Department of Conservation will accept bids July 19 for oil and gas leases on 72,264 acres of land under Lower Mobile Bay and the Gulf of Mexico.

W. H. Drinkard, state director of conservation, said "an agent for an undisclosed principal" had asked that the lands be advertised for leasing. The acreage comprises nine submerged tracts. Smaller inland tracts totaling about 1,000 acres in Choctaw and Baldwin counties also are being offered for lease on the same date.



PERCENTAGE GAINS by districts for 1956 over 1955 show how much the nation's . . .

Gasoline Consumption Goes Up

AMERICAN motorists were busier last year than ever before, burning a record 56,036,947,000 gal. of gasoline.

California still led the field, using 5⅓ billion gallons, and Tennessee became the twentieth state to use more than a billion gallons in a year. Vermont was the smallest consumer. It used 121,718,000 gal.

These were some of the highlights from the latest gasoline report by the American Petroleum Institute.

The report placed the national increase at 1.8 billion gallons, but the 1956 figures are not entirely comparable to those for 1955. Here's why:

For 11 months of 1955, California consumption figures included government purchases of jet fuel as well as gasoline. For one month in 1955 and for all of 1956, jet fuel was excluded from government sales.

This change dropped California's reported 1956 consumption below that of 1955. But an increase in motor vehicles for the state clearly indicates a good increase in gasoline use.

The largest percentage gain was marked up in New Mexico, which consumed 389,125,000 gal. for a 15.7 per cent increase. New York, where sales were up 194,046,000 gal., had the largest volumetric gain.

The distribution of percentage changes were as follows:

. . . **Five states lost or gained** less than 1.0 per cent in consumption.

. . . **Five had increases** of 1.0-1.9 per cent.

. . . **Six states each gained** 2.0-2.9 per cent, 3.0-3.9, and 4.0-4.9.

. . . **Eight gained** 5.0-5.9 per cent.

. . . **Four each gained** 5.9-6.0 and 6.0-7.9 per cent.

. . . **Four gained more** than 8 per cent. These were New Mexico, Florida, Arizona, and Delaware.

The median gain for all states was 4.3 per cent. Percentage gains by states are shown on the accompanying map.

The largest area gain was in PAW District 1 where the average increase was 5.28 per cent. Next in line were District 4, with 4.65 per cent; District 3, with 3.64 per cent; and District 2, with 3.30 per cent.

The gain in District 5 was not calculated since California figures were not comparable for the two periods.

Gasoline Consumption By States

(Thousands of gallons)

	1956	1955		1956	1955
Alabama	886,817	826,043	Nebraska	569,003	568,258
Arizona	390,382	359,695	Nevada	129,118	124,868
Arkansas	552,456	517,455	New Hampshire	184,629	172,206
California	5,333,638	5,615,961	New Jersey	1,846,099	1,806,414
Colorado	638,147	595,459	New Mexico	389,125	336,343
Connecticut	693,553	672,868	New York	3,710,039	3,515,993
Delaware	155,526	143,877	North Carolina	1,311,886	1,254,148
Dist. of Columbia	204,258	207,013	North Dakota	304,501	302,404
Florida	1,533,671	1,373,086	Ohio	3,070,573	2,913,859
Georgia	1,169,369	1,104,241	Oklahoma	943,706	920,464
Idaho	255,445	249,839	Oregon	641,222	620,310
Illinois	2,814,200	2,719,616	Pennsylvania	2,989,211	2,846,509
Indiana	1,717,711	1,641,182	Rhode Island	234,835	233,431
Iowa	1,118,544	1,107,623	South Carolina	664,152	627,314
Kansas	1,039,569	1,027,915	South Dakota	326,654	328,876
Kentucky	817,727	778,836	Tennessee	1,036,984	975,778
Louisiana	876,621	838,359	Texas	4,495,889	4,438,232
Maine	299,605	292,568	Utah	302,813	293,999
Maryland	820,070	768,602	Vermont	121,718	119,007
Massachusetts	1,265,924	1,213,461	Virginia	1,198,877	1,127,364
Michigan	2,485,520	2,446,560	Washington	931,391	868,968
Minnesota	1,202,253	1,152,328	West Virginia	482,601	461,372
Mississippi	610,052	579.838	Wisconsin	1,214,190	1,188,278
Missouri	1,601,864	1,544,227	Wyoming	163,797	162,203
Montana	291,012	276,356	Total U. S.	56,036,947	54,259,606

Alberta Crude Slips

June nominations down 17,479 bbl. below May

CALGARY.—Refiners have cut back slightly in their nominations for Alberta crude oil during June. They are asking for 418,205 bbl. daily, as compared with 435,684 bbl. daily in May.

U. S. refiners want 94,915 bbl. daily of the total nominations. Another 158,025 bbl. will go to refineries in Manitoba, Saskatchewan, and Ontario through the Interprovincial pipeline.

Trans Mountain pipeline will carry 79,085 bbl. daily to refiners on the West Coast, and Alberta refiners will take 67,180 bbl. by truck, tank car, and pipeline.

Imperial Oil, Ltd., is again the biggest purchaser, ordering 149,893 bbl. daily. Of this, 11,000 bbl. is earmarked for working stock for export. Other big purchasers are Shell Oil Co., nominating 66,185 bbl. daily; British American Oil Co., Ltd., 45,290; Canadian Oil Companies, Ltd., 31,000; and General Petroleum Corp., 32,561.

U. S. nominations were Shell Oil Co., Anacortes, Wash., 45,500 bbl. daily; General Petroleum Corp., Ferndale, Wash., 32,561; International Refineries, Inc., Wrenshall, Minn., 8,333; Lake Superior Refining Co., Superior, Wis., 5,333; Bay Refining Corp., Bay City, Mich., 2,000; Dow Chemical Co., Midland, Mich., 500; West Branch Refineries, West Branch, Mich., 333; Union Oil Co., Cut Bank, Mont., 255; and Phillips Petroleum Co., Great Falls, Mont., 100.

Gulf Displays Its Scientific Muscles

PITTSBURGH.—Gulf Oil Corp. last week gave the public a peek into its expanded research facilities. Three new laboratory buildings on Gulf's sprawling 53-acre research center at nearby Harmarville were dedicated during a 5-day round of ceremonies.

The new buildings will house Gulf research into new techniques of oil production and handling well fluids, into fuels and lubricants, and into the field of nuclear energy.

The buildings themselves emphasize how far Gulf has come in industrial research within the short span of 22 years. The Harmarville research center was created in 1935 with only two large research buildings. With the latest structures the center contains 44 buildings and represents a multimillion-dollar investment. (See photos above.)

In connection with the ceremonies, Gulf will formally announce later in the month significant developments in drilling and processing which scientific teams at the center have made.

The buildings dedicated last week included:

. . . The William L. Mellon production laboratory. It is four stories high, houses 95 labs and offices for a staff of 150 scientists and engineers. Projects there include methods of assuring maximum natural flow from oil reservoirs, water and gas injection,

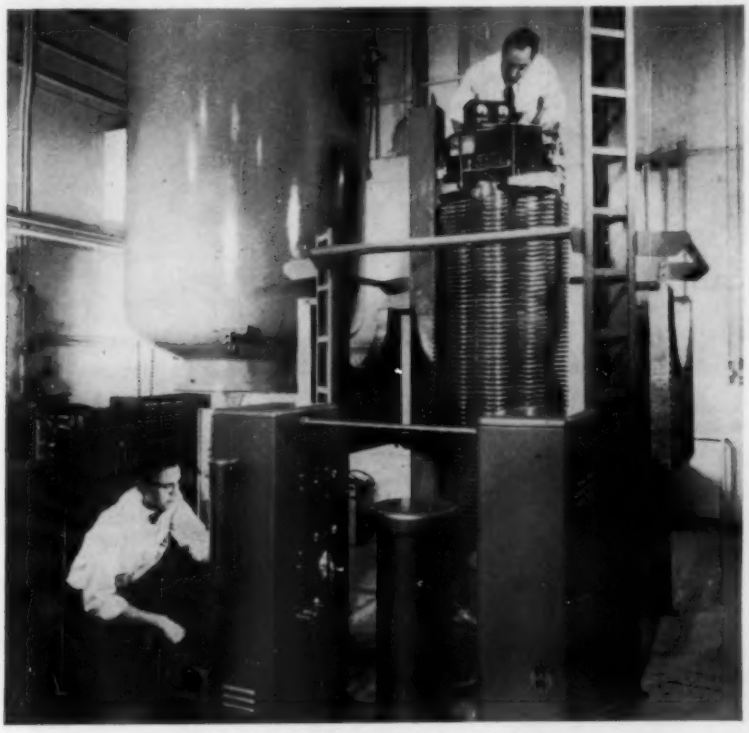
PUSH-BUTTON RESEARCH into engines and fuels is carried on in this new Gulf building.

and the combined effects of heat and gases on greater oil production.

An adjoining drilling building houses an 80-ft. oil derrick and experimental equipment to study new drilling methods.

...The R. B. Mellon automotive products laboratory. This structure is electronically instrumented in such detail that push-button research is possible on many projects. There are 20 room-size engine test cells for evaluating gasolines and motor oils. A king-size cold room permits testing of vehicles up to transcontinental bus size at temperatures ranging from tropic heat to 70° below zero.

...The Andrew W. Mellon nuclear science laboratory. Research projects a ready are begun here ranging from recovering more oil by atomic methods to improving refining by nuclear techniques. Principal tool is a 3,000,000-volt Van de Graaff particle accelerator. This atom smasher is located in the lower two-thirds of the laboratory building, much of it below ground.



ATOMIC PROCESSING opens new vistas.

From irradiated refinery gas . . .

Gulf Gets 130-Octane Blender

PITTSBURGH. — Hexamethylethane may become a common refinery product before too many years.

This 130-octane blending material has just been produced by Gulf Oil Corp. by submitting refinery gases to nuclear radiation.

So far, the petrochemical is a laboratory curiosity. Only small quantities have been made. Costs have been high. But it represents one more piece of information in the jigsaw of future radiation processing which refiners are following closely.

The hexamethylethane project is one of many now under way in Gulf's new A. W. Mellon Nuclear Science Laboratory. The new hot lab boasts a 3,000,000-volt Van de Graaff accelerator. The atom smasher is termed the most versatile radiation source of its type in private industry. It is regarded as the most powerful tool for producing beams of electrons, protons, neutrons, and penetrating X-rays that has yet been applied to research.

The accelerator is housed in a three-story building sunk two floors below ground level. The base of the 20-ft. accelerator is surrounded by massive concrete walls ranging in thickness from 2 to 5 ft. Samples for irradiation are placed on a rotary table which revolves under the atomic particle beam. Remote control mechanisms handle the work observed by closed-circuit television.

Gulf is launched on other radiation work relating to both refining and production. An important project is under way to study the effect of radiation on the activity of catalysts. This is expected to shed new light on the possibility of making catalysts more effective in stimulating chemical changes in hydrocarbon reactions. This important approach to improving present catalytic processes is coupled with work involving radiation of hydrocarbons in the presence of catalysts.

Gulf will pursue the investigation of just how radiation may help by providing an alternate to heat as a source of energy. Radiation can affect an individual molecule without raising the temperature of the total amount of material. It offers a new avenue in exciting reactions since heat alone causes destruction of many materials before certain specific reactions can be brought about. Gulf researchers hope to contribute to the know-how of making entirely new materials from crude oil and upgrading the total product yield from this source.

Nuclear well logging also is being pushed in the new lab. Gamma ray or neutron bombardment of oil field strata in a well bore is being studied to determine their composition and fluid content. This may lead to methods for locating oil otherwise undiscoverable by conventional methods.

The new lab includes facilities for developing new uses for radioactive tracers for control, analysis, and evaluation of materials and processes in refining. Included in this work is the new concept of neutron-activation analysis which has pushed back the horizon of material identification. This procedure consists of irradiating a material and studying the resulting emanations which are given off by the material. It is possible by this means to identify and measure trace elements of a low concentration which defies analysis by any other method.

The new nuclear science laboratory is supervised by Drs. T. J. Hardwick and W. E. Mott. The safeguards designed into it plus the use of the accelerator which can be turned off and on have combined to free the lab work from a "hazardous" classification by insurance companies. This safety aspect holds despite the fact that the accelerator can produce a radiation field several hundred times greater than the most potent radioactive-cobalt source in industrial use.

Big Gas Deal Snagged

● C.A.T.C. group may move offshore gas in intrastate commerce to avoid FPC-imposed 30 per cent price cut.

HOUSTON.—Price controls enforced by the Federal Power Commission against the C.A.T.C. group threatened to delay large-scale shipments of offshore gas in interstate commerce.

Officials of Continental Oil Co., operator for the four-company offshore group, admitted last week that they had not decided whether to go through with the sale of large offshore reserves to Tennessee Gas Transmission Co.

T.G.T. had contracted to buy huge gas reserves from the offshore combine at record prices starting at 22.4 cents and ranging up to more than 35 cents per M.c.f. The contract covered an initial supply of 2 trillion cubic feet of gas. However, over the life of the contract, T.G.T. had agreed to purchase up to 6.6 trillion cubic feet if available.

The FPC, in an unusual ruling, set the initial price at 18 cents per M.c.f., including a 1-cent gathering tax *(The Oil and Gas Journal, May 27, page 93)*. The producers were given 20 days in which to accept or reject the sales certificate.

Charles A. Perlitz, Jr., executive vice president of Continental Oil Co., said last week that no decision had been made following the FPC's surprise ruling. If the FPC certificate is declined, the sale is automatically off.

The FPC agreed to let the producers file for a rate increase 24 hours after deliveries start to the T.G.T. system. This increased rate, however, would be subject to refund in case of an adverse ruling later. As the situation stood last week, C.A.T.C. had the choice of accepting a price cut of nearly 30 per cent or taking the chance on having to surrender the entire gas reserves to the federal Government.

The fields involved are on leases off Cameron and Vermilion parishes in Louisiana. Under the Outer Continental Shelf Act, the leases terminate in August 1958 unless production has started or drilling is in progress.

Intrastate market . . . The FPC's ruling of May 20 led to speculation that C.A.T.C. will try to find an intrastate market for its offshore gas to avoid federal price controls.

Although the fields are in the offshore area claimed by the federal Government, an official of one of the producing companies said company lawyers contend that the gas could be moved to shore in the company's own gathering system without coming under interstate controls.

Deliveries of gas from the offshore reserves were to start next November.

Work was scheduled to begin soon on a 55-mile underwater pipeline to transport the gas to shore *(The Oil and Gas Journal, April 22, page 84)*. Tennessee Gas has accepted bids for construction of the pipeline, but letting of contract has been held up. Brown & Root, Inc., Houston, was apparent low bidder on the job.

Sun Hits in Bay

Latest play in Galveston Bay nets six discoveries

HOUSTON.—Galveston Bay's latest drilling play paid off again last week when Sun Oil Co. opened a new field 3½ miles off the Chambers County shore in the upper portion of the bay.

It's the sixth new-field discovery in the bay since the present exploratory spurt got under way late last year *(The Oil and Gas Journal, April 8, page 177)*.

Sun's new discovery, in State Tract 88, is productive from Frio sand perforations at 8,278-88 ft. It flowed 295 bbl. of 38.7°-gravity clean oil daily, gaged through ¼-in. bottom and 5/32-in. top chokes. Gas-oil ratio measured only 883 cu. ft. per barrel with bottom-hole flowing pressure of 3,670 psi.

Already confirmed . . . Sun is confirming its discovery quickly with its second test — a northeast offset in Tract 73. It was drilled simultaneously with the discovery, flowing 185 bbl. of oil per day through ¼-in. and 9/64-in. chokes with equally low gas-oil ratio and comparable pressures. Perforated interval is 8,272-82 ft.

Two additional tests in the immediate area are nearing the productive zone. One is a southwest offset to the discovery in Tract 99. The other is a 1½-mile northeast stepout in Tract 68.

The new discovery is slightly less than 3 miles north of North Red Fish Reef field, opened by Sun last October, and recently extended 1½ miles northwest and a mile north by "new-pay" gas-condensate discoveries by Tidewater Oil Co. Sun's new discovery is also less than 3 miles southwest of the older Fisher's Reef field.

Fourteen rigs were active in the fast-spreading Galveston Bay development last week.

Record Well Folds

Gulf quits obstinate test after 940 days on the job

PECOS, Tex.—Gulf Oil Corp. last week was pulling casing and preparing to plug its hard-luck 1 P. G. Northrup, the deepest hole ever drilled in West Texas.

The Reeves County deep test 23 miles southeast of here reached its record depth of 18,771 ft. late last year.

The well likely will go into the books as one of the toughest and most costly ever drilled.

Gulf spudded the project January 13, 1952. It originally abandoned the hole at 16,696 ft. in May 1953. Since then it has reentered and abandoned the hole twice, sidetracked it three times due to impossible fishing jobs, and kept a heavy-duty rig on the project all told for about 940 days—almost 2⅗ years *(The Oil and Gas Journal, January 7, page 80)*.

The 1 Northrup held the West Texas drilling-depth record twice before during its 5-year career. It set a new state record in August 1954 when it reached 18,609 ft.

It remains the state's second deepest hole, surpassed only by Magnolia Petroleum Co.'s 417-A West Ranch which was bottomed dry at 19,060 ft. in August 1955 in Jackson County on the Texas Gulf Coast.

The Gulf Oil Corp. project will be abandoned at 18,709 ft. in its third sidetracked hole. Unsuccessful production tests of the interval 18,417 to 18,709 ft. led to the plugging order.

Subsidence Bill Sidetracked

SACRAMENTO. — Long Beach's efforts to cut subsidence were thrown for a 2-year loss last week by the California Legislature.

A bill calling for establishment of a subsidence-abatement district with compulsory unitization provisions was referred by the assembly to an interim committee for further study. The move killed chances of action on the bill at the current session. Next year's session will be concerned with budget matters only.

Top Gas Price Paid

Michigan Wisconsin to buy Oklahoma gas for 17 cents

DETROIT. — Michigan Wisconsin Pipe Line Co. has contracted for a large block of gas reserves in Laverne field, northwestern Oklahoma, at record prices for the area.

Producers will receive 17 cents per M.c.f. for 1,000-B.t.u. gas, which is 2 to 7 cents above most contracts in the area. The price will escalate 2½ cents every 5 years.

Michigan Wisconsin's contract covers about 70 per cent of the acreage in the field. Reserves in this section of the field exceed 250 billion cubic feet. The gas will be sold by Cities Service Oil Co., Pan American Petroleum Corp., Shell Oil Co., Sinclair Oil & Gas Co., Sun Oil Co., and Union Oil Co.

Colorado Interstate Gas Co. has signed up the remainder from Sunray Mid-Continent Oil Co., Gulf Oil Corp., and Champlin Refining Co.

Michigan Wisconsin plans to build a gathering system and 50-mile, 20 to 24-in. line to the No. 1 station in Kansas on its main line to Michigan. Federal Power Commission approval for the contracts and pipeline will be sought this summer.

A detailed study of reserves is due to be completed July 1. The reserves total is uncertain at this point. There are four possible sands in the field.

A gasoline plant is planned by the producers selling to Michigan Wisconsin. The operator will be selected later.

Humble Adding Ethylene

BAYTOWN, Tex. — Construction started last week on a large ethylene-recovery unit at Humble Oil & Refining Co.'s 310,700-bbl. refinery here.

The new plant, announced late last year, is one of the first steps in Humble's expansion in the petrochemical field. It will recover more than 80,000,000 lb. of ethylene annually from refinery gases.

Contractor on the project is M. W. Kellogg Co. Completion of the new unit is scheduled for February 1958, about the time Humble's new fluid catalytic cracking unit will go on stream.

A low-temperature gas-recovery unit will remove hydrogen sulfide from gas streams from three cat units and recover light hydrocarbon components as feed stock for the catalytic polymerization unit, rubber plants, and alkylation plant. Humble plans an ethane cracking unit later.

watching WASHINGTON

. . . with Bertram F. Linz

Look out for 1958 . . .

SOME 75 bills directly affecting the oil and gas industry have been offered in Congress so far this year. Right now, not more than two or three seem to have any chance of passing this session. But it may be different in election year 1958.

"Big Business" will be one of the big issues in next year's congressional campaigns. The oil and gas industry will be a prime target. From now on there will be more and more talk about it. The storm flags are already flying.

Sen. Joseph C. O'Mahoney has induced the Senate to order a new printing of the old Federal Trade Commission report on "The International Cartel" for use of his antitrust and monopoly subcommittee.

The effort to kill the Harris-O'Hara gas bill is based largely on charges of monopoly in the gas industry, present and prospective.

A Senate committee will soon issue a report on concentration in industry. Much emphasis will be laid on oil.

Coal fights back . . .

THE coal industry is out to regain some of the 85 million tons a year of railroad sales it has lost to oil in the past decade.

Not too many years ago the railroads took over 100 million tons of coal a year. Now they take only about 15 million tons and are still cutting down. Railroad fuel is big business. The carriers spent over $363 million for diesel oil last year. But they spent only $69 million for coal.

Coal interests are tackling the problem from three angles. One is through improved equipment, such as the coal-fired turbine engine now being developed. Another is through further electrification of the railways to increase demand for coal-produced power.

But the most interesting is a Buck Rogers idea, which works. The Denver & Rio Grande Western is treating coal with atomic waste after pulverizing it. The result is something like smoke which is mixed with the fuel oil. It gives increased power and the D. & R. G. W. figures it may save 1 cent a gallon on the 40 million gallons of oil it uses each year—or $400,000.

The work in the coal industry is being closely watched by the railroads. Their diesel-oil bill last year was nearly $32 million higher than in 1955. And cost-conscious railroaders know that the price of oil is more likely to rise in the future than to fall.

Helium producers wanted . . .

THE next government monopoly to be given up may be that on helium.

The big problem will be how to interest private enterprise in a business on which the Government has the first call and is the largest customer.

A survey team recommended that the Bureau of Mines get out of the helium business back in 1954. The idea has been under study, on and off, ever since. Recent events have made the matter more urgent.

Demand for helium is increasing at a fast rate. The bureau is bringing new capacity into use this year that will increase output. But it won't be able to keep up with demand very long. Meanwhile, a lot of helium, produced with gas, is going to waste for lack of facilities to extract it.

The survey team said the bureau's four plants should be sold or transferred on contract. It held the belief that private industry would be interested. The Government's interest should be limited to research, but not to the extent of barring operators from that field.

The big question is whether private capital would want to go into a field where the Government and defense plants take more than two-thirds of the output. Government demands can zoom. They also can dive.

Easy Does It!: Three pounds of cobalt in 3 tons of lead casing. That's the protective ratio of this cargo being unloaded at Cities Service Research and Development lab at Cranbury, N. J. The radioactive material has a potency two and one-half times the world's supply of radium. It will test the effects of nuclear radiation on petroleum products. The cobalt was moved into a cave with 42-in.-thick, specially constructed concrete walls. Technicians conduct experiments from outside a 3-ft.-sq. window with 42-in.-thick safety glass weighing 7,500 lb. The door to the cave is lead, 12 in. thick and weighing 15 tons. It can't be opened if the radioactive count in the cave passes a certain level.

U.S. Rubber Output Takes Big Bounce

DURING ITS FIRST full calendar year of full private ownership, the synthetic rubber industry chalked up new annual increases in output all along the line.

The preliminary 1956 report from the United States Tariff Commission shows an aggregate production of 2,314 million pounds, a gain of 11 per cent over 1955 output. The new report does not include vinyl elastomers, which have been regrouped with plastics and resin materials.

S-type rubber, the workhorse of the industry, jumped 10 per cent over 1955, and hit an all-time high of nearly 1.8 billion pounds. New records were reached in all types of acyclics except butyl rubber, which still lags behind 1953 output. However, butyl has reversed a 2-year downward trend to jump almost 34 per cent over 1955.

SYNTHETIC RUBBER PRODUCTION IN THE UNITED STATES
(Thousands of pounds per year)

	1956	1955	1954	1953
Cyclic Elastomers:				
Polybutadiene-styrene (S-type)	1,797,637	1,635,233	973,241	1,414,944
All other (S-types, polyurethane)	10,057	7,446	.....	.....
Total Cyclics	1,807,694	1,642,679	973,241	1,414,944
Acyclic Elastomers:				
Polybutadiene-acrylonitrile (N-type)	76,286	71,458	47,933	45,244
Polychloroprene (Neoprene)	222,700	204,640	154,899	180,308
Polyisobutylene-isoprene (Butyl)	165,841	123,852	130,116	175,923
All other (Thiokol, polybutadiene, polyisobutylene, silicones)	41,512	39,993	23,792	23,567
Total Acyclics	506,339	439,943	356,740	425,042
Grand total	2,314,033	2,082,622	1,329,981	1,839,986

—— *Industry* briefs

Merger of Trans-Tex Drilling Co. of Shreveport and Rimrock Tidelands, Inc., of New Orleans has been approved by stockholders. The surviving company will be Rimrock Tidelands, Inc. Husky Oil Co., which owns all of Trans-Tex, will have substantial interest in the merged companies. The new Rimrock Tidelands will operate six offshore rigs, two inland barge rigs, and four land rigs, all capable of meeting "all types, conditions, and depths of Gulf Coast drilling." Combined oil and gas income from producing properties will be over $1 million a year.

Josaline Production Co. of Oklahoma City has purchased wells and properties of Producers Chemical Co., Amarillo, for about $2 million. Involved were 1,100 acres of leases north of Stinnett in Hutchinson County of the Texas Panhandle and 97 wells averaging 2,000 bbl. daily. Josaline is owned by S. J. and Joseph Singer. Producers Chemical's owners are Henry Rogstz and Henry Glass.

Canyon Oil Corp., Houston, has sold its assets to Ambrosia Minerals, Inc., a Nevada mining firm. Sale involves oil reserves estimated at 2,200,000 bbl., including 36 producing oil wells most of which are in Yates field, West Texas, and 2,000 acres of undeveloped leases in Brazos and Zapata counties.

The deal is one of the first steps in a diversification program recently announced by Ambrosia. The company plans to start development drilling on some of the acquired properties immediately.

The discovery-a-week Paradox basin has picked up another big one. Carter Oil Co.'s 1 Navajo-114, 3½ miles northeast of East Desert Creek field, was completed for 2,300 bbl. of oil a day. Flow was through ¾-in. choke from the Pennsylvanian at 5,546-96 ft. The discovery extends Aneth area production 2 miles to the southeast. It was immediately offset to the south by 2 Navajo-114.

North Texas' biggest fracturing job was carried out last week at the M. O. Rife Production Co. 1 Sanders, 8 miles east of Windthorst in southern Clay County. Dowell Incorporated pumped 150,000 gal. of water and 150,000 lb. of sand to two perforated sections in the Strawn formation. Previous record for North Texas was 100,000 lb. of sand at several locations.

New Orthoflow Converter goes on-stream with CB&I-built Components

When American Oil Company's Orthoflow Fluid Catalytic Cracking unit went on stream in 1956 at their new 35,000-bbl. per day Yorktown, Virginia refinery, it contained a reactor, regenerator, vacuum tower, crude tower, absorber tower and catalyst hoppers fabricated by CB&I and furnished through M. W. Kellogg Company.

This is but one example of the way in which CB&I's complete designing, fabricating and erecting facilities enable them to create special or standard structures to meet the rigid specifications of the petroleum industry. When you plan steel plate structures, plan with CB&I. Write our nearest office for further information.

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Horton Steel Works Limited, Toronto; Chicago Bridge & Iron Company Ltd., Caracas; Chicago Bridge Limited, London; Soriedade Chibridge de Construcoes Ltda., Rio de Janeiro.

CB&I

Pay Hike Signed

Texaco is first major to make new labor contract

PORT ARTHUR, Tex.—The Texas Co. became the first major refiner to sign a new labor agreement granting a general pay increase of 5 to 6 per cent along with several fringe benefits.

The pay raise, which apparently has set the pattern for settlements with the Oil, Chemical, and Atomic Workers International Union, will be a 5 per cent increase retroactive to April 1 and 6 per cent effective May 1.

The contract covers some 4,000 O.C.A.W. members at the Texaco refinery in Port Arthur. About 300 members of another O.C.A.W. local at Texaco's Port Neches, Tex., plant have authorized a settlement on the same terms.

Several other companies have followed the Texaco move with a similar offer.

In addition to the pay increase, the Texaco agreement provides for 4-week vacations after 20 years of service and for pay at two and one-half times the normal rate for work done on any of eight holidays. Most companies now in negotiations with refinery workers have agreed to the latter provisions.

Can States Fix Gas Prices? High Court to Decide Next Fall

WASHINGTON.—The right of a state to fix prices on natural gas going into interstate commerce will be tested before the U. S. Supreme Court next fall.

The court last week agreed to decide whether Kansas can fix minimum prices for gas.

A 1955 decision held that Oklahoma could not do so. But the Oklahoma law was to apply after processing, and the court held that the gas then was under federal control. The Kansas order, adopted in 1953, fixes the price at the wellhead.

The order was upheld last December by the Kansas Supreme Court. It came before the Washington tribunal on an appeal by Cities Service Gas Co.

The company argued that since the gas was to move in interstate commerce, the Federal Power Commission, not the state, had jurisdiction.

Both the nullified portion of the Oklahoma law and the contested Kansas order were to apply to Hugoton field *(The Oil and Gas Journal, December 17, 1956, page 86).*

Pipeline briefs

A second crude pipeline is planned from fields in southwestern Kansas and northwestern Oklahoma. Oil Field Pipe Line, Inc., has received a charter and plans to seek a state permit for an 8 and 12-in. line from near Elkhart, Kans., to Ellinwood, Kans., at the Schurr station of Arapahoe Pipe Line Co. Capacity would be 25,000 bbl. per day.

Pierce C. Musgrove, president of Musgrove Petroleum Corp., Inc., Wichita, is president of the new company. Musgrove is a producer in this area which lost its market to growing Texas production April 1. Southern Kansas Pipeline, Inc., backed by Aladdin Petroleum Corp. and Anderson-Prichard Oil Corp., has proposed a 200-mile, 6 to 10-in. line to serve the same area. It would terminate at Arkansas City, Kans.

Florida Pipeline & Storage Co., a subsidiary of Onego Corp., Uniontown, Pa., plans to build a 67-mile products pipeline from Port Everglades, Fla., to Homestead Air Force Base, 25 miles south of Miami. Fish Service Corp., Houston, has the contract to engineer and build the line. Some storage also will be built. Florida Pipeline expects to be operating the system in December.

Throughput of Trans Mountain Oil Pipe Line Co. is expected to drop from 200,000 bbl. daily in May to 175,000 bbl. daily in June. The reason is a reduction in the demand for offshore loadings at Vancouver. Trans Mountain had expected deliveries to remain at the 200,000-bbl. level.

El Paso Natural Gas Co. has started building an 8,100-hp. compressor station 17½ miles west of Shamrock, Tex., in the Gray County portion of Panhandle field. Contractor is C. F. Braun, Los Angeles. R. H. Fulton & Co. is laying 100 miles of 18-in. between the station and El Paso's system at Dumas, Tex. El Paso plans to drill 400 wells in the area in the next 3 to 4 years and will lay a gathering system when production warrants.

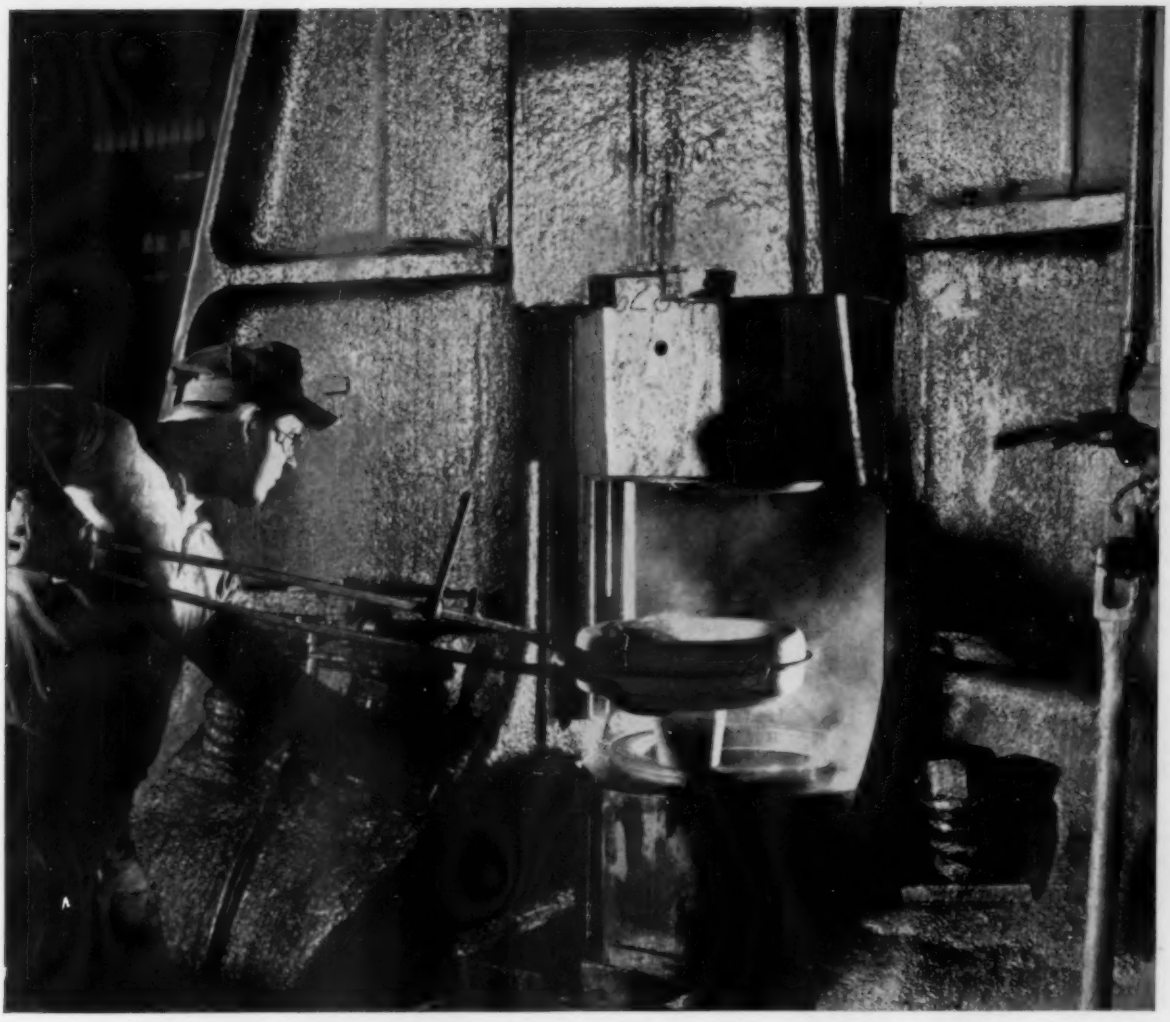
Texaco-Cities Service Pipe Line Co. has received bids on a 170-mile, 6-in. products pipeline from East Chicago, Ind., to Lowell, Mich., in the Grand Rapids area. Construction will start this month. The line is expected to be operating late this summer, transporting L.P.G. Deliveries will be made in the Griffith and South Bend, Ind., areas, and in the Grand Rapids area.

Ohio Fuel Gas Co. has started a $1½-million project to expand its Holmes underground-storage capacity by 5.3 billion cubic feet. Fifty-one producing wells are being converted to storage. Ten more wells will be drilled this year and nine during 1958. Sixteen miles of 3, 4, and 6-in. pipe will tie the wells into Ohio Fuel's system. The company draws on storage for 55 per cent of its peak winter requirements.

Also for Pipeliners . . .

A new natural-gas bill may emerge from drawn-out hearings before House commerce committee. Whether it will please anyone is the question (P. 63) . . . One observer says the oil and gas industry needs a strong information spokesman in Washington and needs to do missionary work with the folks at home (P. 65) . . . The C.A.T.C. group may not go through with its gas deal with Tennessee Gas Transmission after recent FPC ruling. Instead the group reportedly is studying possibility of moving gas in intrastate commerce (P. 72) . . . A top price of 17 cents per M.c.f. is being paid gas producers in Laverne field of northwest Oklahoma by Michigan Wisconsin (P. 73) . . . The U. S. Supreme Court will be asked to decide this fall if a state can fix prices on natural gas going into interstate commerce. The case will come up from Kansas (P. 76) . . . Union Oil is proving in California that low gravity, highly viscous crude can be handled also in L.A.C.T. units (P. 80) . . . Aramco has completed tests on the first gas-combustion turbines ever installed on crude or products lines. They have helped increase line capacity to 350,000 bbl. daily (P. 85).

PLUS THESE TECHNICAL FEATURES: How Shell's automatic custody transfer system works (P. 90) . . . Automatic operation at 10 gas-turbine stations of El Paso Natural (P. 115) . . . and Pipeline Patrol tells how dry ice can be used as a welding plug on crude lines (P. 131).



With Every Blow of the Hammer, Strength is Pounded In

The ram of the forging hammer strikes with an almost incredible force. But it neither shatters nor ruptures the hot steel beneath it. Instead it actually "pounds in" strength, and at the same time causes the steel to be shaped by the dies.

The photograph above shows an everyday occurrence in the Bethlehem drop-forge shops. There a large battery of steam and board drop hammers is constantly at work, pounding out strong, sturdy forgings of many different designs. Some of these pieces weigh as little as a pound. Others, like the one in the picture, run big.

For years Bethlehem has been making drop and other closed-die forgings for the petroleum, mining, aviation, automotive, and electrical industries, to name but a few. Both quality and variety are assured by excellent facilities, which include die-sinking shops, hammers to 8,000 lb, mechanical presses to 3,000 tons, and full heat-treating equipment.

Bethlehem drop forgings are available in weights ranging from one to 250 lb. No matter what size or design you require, we can handle it to your entire satisfaction. Call us when next in the market.

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Permian Boosted

Tidewater wildcat shows four possible pay zones

HOBBS, N. M.—Tidewater Oil Co. 6 Coates 4 miles east of Jal is making operators take a new look at the Permian basin. It could set up the basin for many more years of exploratory and development drilling.

The well is located in one of the old shallow fields of the basin. It not only got a heavy flow of oil from the Ellenburger but also got flows from two deeper zones and a show in a fourth.

Drilling reports show a possible 295-ft. section in the Ellenburger. Top of this formation, however, has not been determined exactly. First oil shows came at around 7,734 ft. The well made a number of flows after drilling below that point. And at 7,974-8,029 ft. it gaged 92.94 bbl. of clean oil in an hour. Maximum bottom-hole flowing pressure was 3,220 psi.

Operators recovered clean oil on drill-stem tests of the Clear Fork. Later, the well flowed 20 bbl. an hour from the Tubb zone and better than 50 bbl. an hour from the McKee. The Tubb is Middle Permian and the McKee is Middle Ordovician.

The well was continued to contract depth of 9,700 ft.

Alaska Development Near?

WASHINGTON. — Statehood for Alaska may pave the way for development of the territory's submerged oil resources before Congress can act on specific legislation to that end.

The House insular affairs committee approved statehood last week by a 24 to 6 vote. If the House passes the bill a Senate committee is ready to take it up promptly.

A bill to open the territory's underwater areas is pending in a House committee *(The Oil and Gas Journal, May 27, page 98).*

Processing briefs

Magnolia Petroleum Co. may enter the petrochemical field. President J. L. Latimer, Dallas, said a committee is studying the feasibility of such a move, but no concrete recommendations have been made yet. The firm would either set up its own plant or join forces with other interests. Latimer made the announcement at a dinner in Beaumont honoring R. G. Sanders, Magnolia's new refining vice president.

Esso Research & Engineering Co. has a green light for its new Florham Park, N. J., research center. A local permit was unanimously granted for development of a 650-acre private estate which will form a nucleus for Esso's future laboratory complex.

The move was necessitated by the fact that Esso Research has already outgrown its Linden, N. J., center. The Linden center was built less than 10 years ago. The new site provides plenty of elbowroom in a rural setting. Initial installations will include an office building, a laboratory, a prototype building for process research units, a service building including a steam generating plant, and a gate house.

Warren Petroleum Corp. has plans for a gasoline field plant to handle 100 million cubic feet of natural gas in the Oklahoma Panhandle. But construction hinges on the price tag the Federal Power Commission puts on the gas.

The plant would probably be located between the Mocane and Laverne areas on the major pipeline system of Colorado Interstate Gas Co. Colorado has been granted permission to build a 50-mile, 22-in. line to tie into the Mocane area in Beaver County. Warren's plans include a gathering system to fields to be served by the plant.

Commercial Solvents Corp. has opened bulk methanol terminals in Los Angeles, San Francisco, Portland, Ore., and Tacoma, Wash. Terminal price at all four distribution centers will be 31 cents per gal., f.o.b. terminal. West Coast tank-car delivered price remains unchanged at 35.5 cents per gal. Delivery to the new terminals will be made by a converted C-4 cargo ship from the firm's Sterlington, La., plant.

Gulf Oil Corp. has developed a new method for detecting arsenic and other catalyst poisoning, which may save the company millions of dollars. The company's "trace analysis" combines the latest microchemical techniques with the old fashioned Gutzeit police test for arsenic poisoning in human beings.

Gulf researchers use a spectrophotometer to determine arsenic content at lower concentrations than ever before possible—one part per billion. To rework or restore poisoned catalyst would run about $300,000 for the catalyst charge to each of the firm's large modern reforming units.

Also for Refiners . . .

Commerce Oil has closed financing and custom-refining deals that apparently assure it can build a 43,000-bbl. refinery in the Narragansett Bay area of Rhode Island (P. 61) . . . Motorists in the U. S. are getting most for their money in gasoline, a price survey of the world reveals. Prices for premium in other countries range from 53 to 92 cents (P. 66) . . . Octane ratings of U. S. motor fuels have taken another jump. Premium averages 98 R.O.N. and regular to 90.8 (P. 68) . . . The United States used a record 56 billion gallons of gasoline last year, up 1.8 billion gallons from the year before (P. 69) . . . Gulf researchers have made hexamethylethane by irradiating refinery gas. The product is a 130-octane blending material (P. 71) . . . Humble starts work on ethylene-recovery unit at Baytown refinery (P. 73) . . . Private industry has made some big strides in synthetic rubber production during the first full year of ownership (P. 74) . . . Texaco becomes first major refiner to sign new labor contracts granting pay increases (P. 76) . . . Harry Bass & Sons plans to build an $18-$20-million natural-gasoline plant in Pembina field of Alberta (P. 80) . . . BP Trading has raised the price of Persian Gulf crude by 13 cents a barrel. Others are expected to follow (P. 81).

PLUS THESE TECHNICAL FEATURES: Tips on solving alkylation feed problems that come with changing compositions of olefin and isobutane charge streams (P. 93) . . . Advantages of kaolin catalyst in cat cracking (P. 95) . . . How ripple trays solved some vexing problems (P. 103) . . . Refinery construction index (P. 117) . . . Questions on Technology (P. 119) . . . Refiner's Notebook (P. 121) . . . and Field Processing (P. 123).

Congrats and $25 to Mrs. JEWEL SUMMERSILL, Humble Oil & Refining Co., Baytown, Texas, for this quip.

There's no sleeping at Lone Star Steel. Lone Star's big plant is almost as bright at night as in the sunlight! Our friend Joe Roughneck needs pipe . . . fine API casing, tubing and line pipe . . . and we are delivering on the double!

One of these days, we will deliver more fine quality, fully normalized pipe. We're making real progress on construction of our new open hearth furnace and stretch-reducing mill . . . keeping faith with Joe Roughneck to supply his oil country pipe needs.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.

Lone Star STEEL COMPANY

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THESE POSITIVE-DISPLACEMENT meters are part of a California setup where...

L.A.C.T. Handles Heavy Crude

LOS ANGELES. — Automatic custody transfer systems can handle low gravity, highly viscous crudes. This is being demonstrated daily at a Union Oil Co. installation in Yorba Linda field near here.

The system is used to account for 2,200 bbl. daily of crude purchased by Union from Western Gulf Oil Co. It is the first installation in California allowing one company to buy crude directly from another through positive-displacement meters.

Several factors make the Union-Western Gulf deal unusual:

...**Meter proving** is on a gravimetric basis rather than by volume.

...**The thick, sticky crude** is heated and kept hot during the transfer.

Both actions are necessary because of the heavy crude handled. Crude from one area averages 12.8° gravity and has a viscosity of 20,000 S.s.U. at 100° F. Another crude from a deeper pay zone averages 15° gravity and has a viscosity of 3,800 S.s.U. at 100° F. Currently these crudes are being blended and heated to a temperature of about 150° F. before being delivered to the L.A.C.T. unit.

The highly viscous characteristics ruled out use of volumetric measuring in the proving tank. The crude would stick to the walls of the proving tank and result in too large an error. But where the oil is weighed this characteristic made no difference. Nor did the variable temperature conditions which arise from handling a crude at 150° F.

The heating system . . . Constant shipping temperatures are obtained by a hot-water circulating system.

The entire piping manifold, including the meter and strainer bodies, is wrapped with ½-in. copper tubing. Sections of the proving system not in continuous use also are wrapped with the tubing. Water heated to 200° F. is circulated in the tubing and keeps the crude in a fluid state.

How it's proved . . . The proving is made under actual operating conditions.

This is made possible by a three-way valve. It allows the flow to be switched to the proving tank without stopping the shipping pump. The two meters themselves are proved bi-monthly.

The meters are equipped with dual counter-printer attachments, one of which is used only for proving the meter. An automatic temperature recorder furnishes a record of the line temperature while 250 gal. are run to the proving tank.

Specific gravity of crude in the prover tank is determined from a representative 500-m. sample. After the specific gravity reading is corrected for temperature, the reading is converted into pounds per gallon at 60° F. These figures are used to convert the weight, as registered on the dial platform scales, into gallons. The corrected gallonage as measured in the prover is then divided by the net metered gallons to determine the meter factor. Results of the two or three proving runs must not differ by more than 0.0005.

Automatic line sampling is made by means of a chemical-feeder pump which is operated from the reciprocating rod of the shipping pump.

Boon to pressure maintenance:

Bass Plans Pembina Gas Plant

CALGARY. — Harry Bass & Sons, Inc,. will build an $18 to $20 million natural-gasoline plant in the sprawling Pembina field of Alberta.

Detailed engineering plans are being prepared. The Alberta Oil and Natural Gas Conservation Board has given tentative approval to the big project. Hearing on Bass' application for a permit will be held July 2.

Bass has already signed contracts to take gas from more than 85 per cent of Pembina's 2,000 producing wells. Disposition of the gas when processed will be left up to the individual owners, Bass said. They may either sell it or reinject it for pressure maintenance.

Flaring order . . . Early in May, the Alberta conservation board issued an order prohibiting the flaring of gas in the field after November 1, 1958. However, months before the order was handed down, the Pembina operators' committee had been conducting full-scale studies on how to dispose of the gas.

The Bass proposal was selected by the operators' committee as the best of several plans designed to conserve the natural gas and to develop pressure maintenance in the field.

Cost of gas processing under the Bass plan will be shared by 40 operators in the field.

Other projects . . . Pembina is one of the largest fields on the continent, covering 347,200 acres. Daily average production 2 weeks ago was 120,000 bbl.

Since the pool discovery nearly 4 years ago, several companies have water flooded some areas.

But natural gas is looked upon as possibly the most economic for large scale secondary-recovery development.

Persian Gulf Prices Up

● BP Trading initiates long-awaited Middle East move with 13-cent increase. If new prices stick—and many believe they will—it's good news for western oil men

WESTERN HEMISPHERE oil men got their best news in months last week: Persian Gulf crude prices started moving upward for the first time in nearly 4 years.

The action rivaled in importance to the industry the January price increases posted for United States and Venezuelan crude.

BP Trading, Ltd., marketing subsidiary of British Petroleum Co., Ltd., broke the ice. It raised posted prices for all crude it lifts in the Persian Gulf by 13 cents per barrel. Effective date was May 28.

BP Trading also made another innovation. For the first time it posted prices for products lifted at the Abadan refinery. These postings were made effective May 29.

Who next? . . . The key question now—just as in similar price swings in the United States—is this: Will other companies follow the BP leadership in putting their prices up too?

If none follows BP Trading, this company naturally will be forced to return prices to former levels. All companies purchasing in the Middle East, however, reportedly were studying the price situation. Others were expected to make a move quickly. Industry sources in this country believed the price increases would stick.

What it means . . . The higher prices for Persian Gulf crude could have a wide effect on oil the world over. Here are some of the implications:

. . . Recent U. S. and Venezuelan price increases would be firmed up. Low Persian Gulf prices had kept pressure on increases made in the Western Hemisphere 5 months ago. Some industry sources had reasoned that sooner or later Persian Gulf prices either had to go up or U. S. Gulf Coast prices would fall.

. . . Imports to East Coast refineries from the Middle East will be less attractive to the extent of 13 cents per barrel.

. . . Persian Gulf prices are breaking farther away from dependency on U. S. Gulf Coast postings. For example: When U. S. prices rose 25 cents a barrel in 1953, Persian Gulf prices followed with a 22-cent rise. The recent U. S. increase varied from 25 to 40 cents. And in contrast the Persian Gulf increase, at least initially, of 13 cents was about one-half to one-third of the U. S. gain.

The new BP Trading price list recorded these changes in postings:

. . . Kuwait crude lifted from Mina-al-Ahmadi, $1.85 per barrel for 31°-31.9° gravity.

. . . Iraq crude from Fao, $2 for 36°-36.9° gravity.

. . . Qatar at Umm Said, $2.21 for 40°-40.9° gravity.

. . . Iran at Bandar Mashur, $2.04 for 34°-34.9° gravity.

. . . Iran at Abadan, $1.99 for 34°-34.9° gravity, and $1.80 for 31°-31.9°.

BP Trading did not change the price of Iraq crude lifted on the Mediterranean Coast. When the Iraq Petroleum Co., Ltd., reopened its pipeline system earlier this year the posted price of $2.69 for 36°-36.9°-gravity oil was 23 cents higher than when the line shut down.

Circle completed . . . If BP Trading's price increase sticks, it will mean that the world's four leading oil centers have all made hikes in prices within 6 months.

Here's the previous sequence:

. . . Eastern Mediterranean prices rose 23 cents per barrel. Parent companies of Arabian American Oil Co. posted these increases at the Sidon terminal of Tapline after the Suez Canal and I.P.C. lines were closed during the Middle East crisis.

. . . U. S. crude prices rose 25 to 40 cents early in January.

. . . Venezuelan prices increased 5 to 35 cents later the same month.

Products postings . . . A sampling of BP Trading's first postings for products at Abadan refinery shows:

Avgas (10545), 19 cents a gallon; 73-octane clear, 5.5; aviation turbine, 9.6; gas oil 53 D.I. (Min.), 9.5; blending distillate No. 2 fuel, 9.1; furnace oil, $2.30 per barrel.

Rash of New Lake Drilling Due

THE CROP of winning bidders for new Lake Maracaibo acreage is losing no time rigging up for tests to find out how good the new acreage actually is.

At least five wildcats are expected to be under way by the end of the month on the lake. In addition one well may be completed soon on concession blocks awarded last year.

Sun Oil Co., the first operator to drill on new lake acreage, is below 10,000 ft. in its SVSX-1. Reports current in Venezuela were that the wildcat found less than 20 ft. of promising Miocene sand.

Sun is operator for a four-company group which acquired Block 12, covering 24,700 acres, for $1,325 per acre. It has 23⅓ per cent interest. Other companies with varying interests are Seaboard Oil Co., Atlantic Refining Co., and Pan Venezuelan Oil Co. *(The Oil and Gas Journal, May 20, page 128).*

A location for Sun's second test is staked in the southern part of the concession. The test is scheduled to 11,500 ft.

San Jacinto Petroleum Corp., expects to spud a test by mid-June on Block 10. The company holds 25 per cent of the 24,700-acre tract acquired for $1,965 per acre. Phillips Petroleum Co. has 45 per cent. The remainder is held by El Paso Natural Gas Co., Sunray Mid-Continent Oil Co., and Western Natural Gas Co.

Signal Oil & Gas Co., operator for a four-company group on a 27,600-acre lake concession acquired for $1,220 per acre, expected to have a well drilling last week.

Superior Oil Co. plans to have two rigs drilling by the end of the month on its 7,774-acre Group 75 acreage in the lake's national reserve for which it paid $2,831 per acre.

Reports, meanwhile, indicate Mene Grande Oil Co.'s offset in the lake is running several hundred feet lower than its Ceuta discovery. The 2 Ceuta is less than a half mile northeast of the discovery. It was logged to 9,600 ft. All Miocene sands were wet. But the parent company, Gulf Oil Corp., has reported several hundred feet of Miocene and Eocene oil producing sections *(The Oil and Gas Journal, March 2, page 119).*

Honduras Search Near

Shallow strat test due this month in Santa Barbara by American group which bought out Petroleos Honduranos

THE AMERICAN COMBINE which just moved into Honduras hopes to spud a test before July on its 11,000,000-acre concession. Aerial photography and surface work was due to start immediately.

The group is made up of seven American independents, McRae Oil & Gas Corp.; American Maracaibo Co.; Justiss-Mears Oil Co.; Western Hemisphere Petroleum Corp.; Oil & Gas Property Management; Georesearch, Inc.; and Col. D. Harold Byrd of Dallas.

It gained the big concession, which covers most of Santa Barbara and Olancho provinces, with the purchase of Petroleos Honduranos, S.A., The group will continue to operate under the name, but the company office at Tegucigalpa will be restaffed.

Petroleos Honduranos has the concession for 20 years. It must drill its first well by July 9 and must be capitalized at $300,000 by September 26. The firm is now capitalized at $100,000.

Under the concession agreement, the Honduran Government will get 25 per cent of the net profit if oil is found. The concession will remain in force without rental payments as long as exploration is continued. A successful well would hold 1,250 acres.

By January 1958 the company must pay $100,000 if it keeps the entire 11,000,000 acres. If it decides against this, it has the option to select 2,000,000 acres in three contiguous blocks without further payment.

Preliminary reconnaissance indicates that only about 2,000,000 acres of the total area is favorable for oil deposits (see map).

First test . . . Petroleos Honduranos' first test will be a 400-ft. strat test downdip from an oil seep in Santa Barbara Province. The syndicate feels that this area offers the best chance for developing commercial production.

Along with this, Santa Barbara territory is easier to reach. Plans are to float drilling equipment most of the way to the site up the Rio Ulua, a husky river emptying into the Gulf of Honduras on the country's northern coast near Puerto Cortes. The equipment will be transported overland the rest of the way through rolling hills.

Petroleos Honduranos has access to geological work which shows that portions of its acreage in both provinces overlie what it believes is a large interior basin.

The theory is that marine sediments were deposited in the basin during Mesozoic times. The company thinks that sediments may be deeper than 20,000 ft. and that the area will have a nonmetamorphic section of more than 10,000 ft.

The company has a problem, however, in that the marine sediments are partially covered by red beds and tuffs. The tuffs tend to mask detailed Mesozoic structures. And the geologists must try to find locations where the tuffs have been eroded.

Second to try . . . Honduras has no commercial oil production, but promising oil seeps and a large number of favorable structures have been evident for many years.

Entry of foreign capital was discouraged by the country until 1954 when it passed a new and much more liberal oil law. Since then interest has perked up.

Petroleos Honduranos is the second company to try for oil in Honduras under this law.

The first was also an American combine of independents—and with a highly similar name, Cia. Petrolera Hondurena, S.A.

The latter took a 48,000,000-acre concession along the country's 315-mile north coast in 1954. About 16,000,000 acres of the total is in upland grasslands. The rest is in coastal bays and islands and on the Continental Shelf which extends roughly 30 miles out into the Gulf of Honduras.

The initial concession owners included John L. Sullivan, president of Texon Drilling Co., Corpus Christi, and O. R. Seagraves and David C. McCord, both of Dallas.

The group drilled a dry hole near the Laguna de Caratasca in the Mosquitia territory on the north coast about 80 miles from the Nicaraguan border. A controlling interest in the firm later was purchased by John Mecom, Houston independent.

Petroleos Honduranos' first test in Santa Barbara will be at the opposite end of the county near Guatemala.

South Korea Seeks Refinery

South Korea has invited three American oil companies to discuss building a refinery in the country.

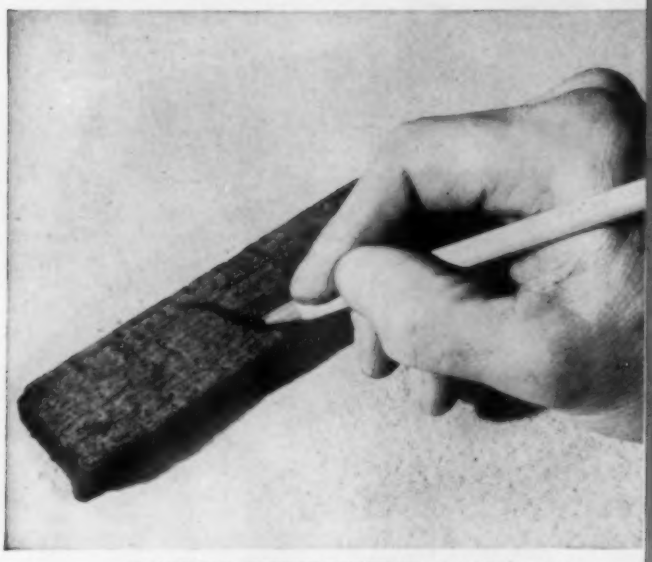
The ministry of commerce and industry said last week that Gulf Oil Corp., Standard-Vacuum Oil Co., and California Texas Oil Co. have all been invited to survey South Korea with refinery construction in mind.

The ministry said Gulf and Stanvac have already proposed building a refinery there, but want legislation to give them safeguards for the investment. Talks with all three companies can proceed, the ministry said, pending the passage of such legislation.

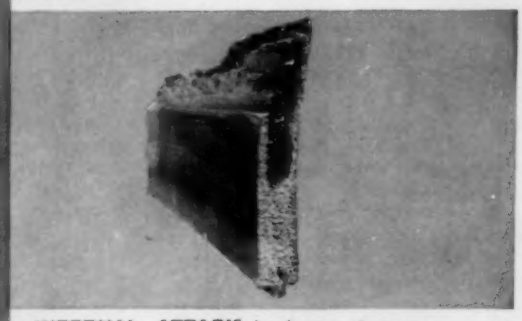
Reports from Seoul indicate a bill is now under study which would guarantee the right of withdrawal of investment capital; assure income-tax exemption for technicians and engineers; and prohibit expropriation of an investor's property or assets.

Why Cooling Towers Fall Apart

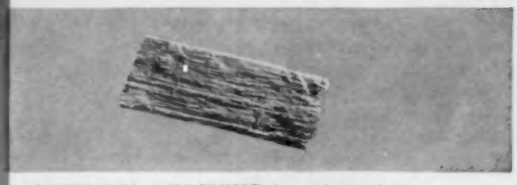
. . . and how to prevent it!



SURFACE DETERIORATION of cooling tower lumber sample has softened wood so that an ordinary pencil gouges it deeply.



INTERNAL ATTACK by fungus gives no warning of impending collapse. Outer wood surface looks perfectly sound.



CHEMICAL LEACHING from chemicals in water weakens wood, dissolves wood components that resist attack by fungi and bacteria.

Cooling towers often almost literally commit suicide because efficient cooling sets up ideal conditions for deterioration of the best woods used in their construction.

WHAT HAPPENS? Warmth and moisture present in cooling towers are perfect for microbiological growth . . . specifically, the bacteria and fungi which destroy wood. Cooling tower lumber is naturally resistant to these organisms — until the flow of water, containing chemicals either naturally present or added for slime, algae, scale or corrosion control, leaches out the materials which provide this resistance.

Some microbiological growths destroy the cellulose which gives wood its structural strength. Others remove the lignin that is a binder of wood's components. Either way, or both, mean expensive trouble . . . worse if the attacking fungi cause internal decay which can easily go undetected until too late to take protective measures.

PREVENTIVE PROGRAMS

Since cooling towers function with piping and other equipment which must be protected from slime, scale and corrosion, it is evident that measures taken to prevent wood rot and leaching should not interfere with other system treatments — and vice versa.

This is Nalco's cue to enter the picture. The Nalco System takes *all* phases of protection into consideration . . . applies treatments that are compatible with each other . . . and with the cost accounts. A phone call or letter will bring the best efforts of the world's largest water treatment organization to bear on your problems.

★ ★ ★

A magazine article "Why Cooling Towers Decay," goes into detail on the subject. Is available as Nalco Reprint No. 58. Your copy free on request.

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March Output Set Record

● All-time high production in Venezuela and the U. S. was big factor in pushing free-world figure to new peak

FREE-WORLD crude production in March reached an all-time high of 15,271,900 bbl. daily, the second record in a row made with the Suez Canal shut down.

The over-all production gain of 30,200 bbl. daily was comparatively small. But when the month ended, spot charter tanker rates were cracking, restrictions on oil use were ending fast in many countries, and O.E.E.C.'s oil committee had stopped making special allocations.

Here are some of the highlights when the tide turned:

... United States output of 7,717,000 bbl. daily was at a record high. The peak was due a gain of 35,000 bbl. daily, largely the result of the 18-day allowable set by the Texas Railroad Commission.

The high allowable backed up increased crude and products emergency shipments to Europe from the U. S. Gulf. The oil lift reached a peak of 820,000 bbl. daily in mid-March.

... Kirkuk field production headed toward the Mediterranean Coast again through the partially repaired Iraq Petroleum Co., Ltd., pipeline system.

Output from the giant anticline and nearby smaller fields in northern Iraq averaged 139,700 bbl. daily, about one-fourth of the October level.

This additional production raised total Iraqi output to 319,000 bbl. daily, a gain of 60 per cent over February.

The area as a whole declined 91,400 bbl. daily, the first drop since the crisis hit. Kuwait had the biggest decline, off 161,000 bbl. daily, or 16.2 per cent, to 834,000 bbl. daily. Iran was off 106,000 bbl. daily, or 14.4 per cent, to 633,000 bbl. daily.

... Venezuela averaged 2,923,610 bbl. daily, a new record achieved by a gain of 73,400 bbl. daily. The first quarter average was 2,855,500 bbl. daily, up 20.8 per cent over the first 3 months of 1956.

The March record was a gain of 387,000 bbl. daily in the 5 months since the Middle East trouble began. But the over-all rise was not an across-the-board increase for all companies, which did not necessarily share in the gain according to their size.

Cia. Shell de Venezuela, the second-ranking company in the country with 933,100 bbl. daily, had the lion's share of the gain since October. It increased its output by 210,900 bbl. daily, accounting for more than half of the country's increase.

Creole Petroleum, the largest producer with 1,233,100 bbl. daily, had a gain of 121,300 bbl. daily in the 5-month period, a little less than a third of the increase.

Mene Grande, Socony Mobil, and Richmond accounted for most of the remaining gains. Mercedes and Atlantic Refining had production about par with October. Affiliates of The Texas Co. and Sinclair each had a slight decline.

World-Wide Crude-Oil Production

(Daily average in thousands of barrels)

Country—	March 1957	Feb. 1957	March 1956
Western Hemisphere:			
Argentina	91.6	91.6	82.9
Bolivia	9.8	9.9	8.2
Brazil	24.7	24.7	6.9
Canada	525.0	528.5	461.2
Chile	11.0	10.8	9.1
Colombia	122.9	123.0	117.2
Cuba	1.1	1.0	1.5
Ecuador	9.7	9.7	9.9
Mexico	250.0	250.0	255.8
Peru	53.7	53.7	46.8
Trinidad	89.4	87.6	75.5
Venezuela	2,923.6	2,850.2	2,392.0
Total	4,112.5	4,040.7	3,467.0
W. Europe & Africa:			
Algeria	0.4	0.4	0.9
F. Morocco	1.6	1.6	2.4
Egypt	15.0	15.0	38.1
Austria	61.1	61.1	64.2
France	28.5	29.1	23.2
W. Germany	72.4	72.3	64.5
Italy	20.1	20.4	7.9
Netherlands	25.6	24.8	19.2
Turkey	6.5	6.5	4.8
United King.	1.6	1.6	1.5
Yugoslavia	7.5	7.5	5.1
Total	240.3	240.3	231.8
Middle East:			
Bahrain	30.0	30.1	30.0
Iran*	633.0	739.0	539.0
Iraq†	319.0	199.7	715.8
Israel	1.1	1.1	0.3
Kuwait	834.0	955.0	1,175.1
Neutral Zone	40.0	40.0	29.5
Qatar	122.3	125.7	125.1
Saudi Arabia	784.7	724.9	1,009.0
Total	2,764.1	2,855.5	3,623.8
Other Asia:			
British Borneo	120.0	120.0	177.3
Burma	4.5	4.5	4.1
India	9.2	9.2	7.5
Indonesia	285.0	270.0	240.9
Japan	6.4	6.6	6.0
New Guinea	7.0	7.0	7.1
Pakistan	5.9	5.9	6.0
Total	438.0	423.2	388.9
Free World:			
Foreign	7,554.9	7,559.7	7,711.5
United States	7,717.0	7,682.0	7,278.0
Total	15,271.9	15,241.7	14,989.5
Communist countries in Soviet orbit:			
Romania	220.0	220.0	200.0
Russia	1,860.0	1,835.0	1,550.0
Others	50.0	50.0	50.0
Total	2,130.0	2,105.0	1,800.0
World total	17,401.9	17,346.7	16,789.5

*Includes estimated 4,000 bbl. daily from Naft-i-Shah field not operated by consortium companies. †Includes estimated 5,000 bbl. daily from Naft Khaneh field, operated by British Petroleum Co.

Figures are from reliable industry reports or official government sources. Data for Communist countries in the Soviet orbit, which includes the European satellites and Red China, are based on competent estimates. Authentic information is not available on month-to-month production in these areas. Estimates also were made for those countries, particularly in Southeast Asia, where complete current reports are lacking.

TREND OVER THE LAST YEAR

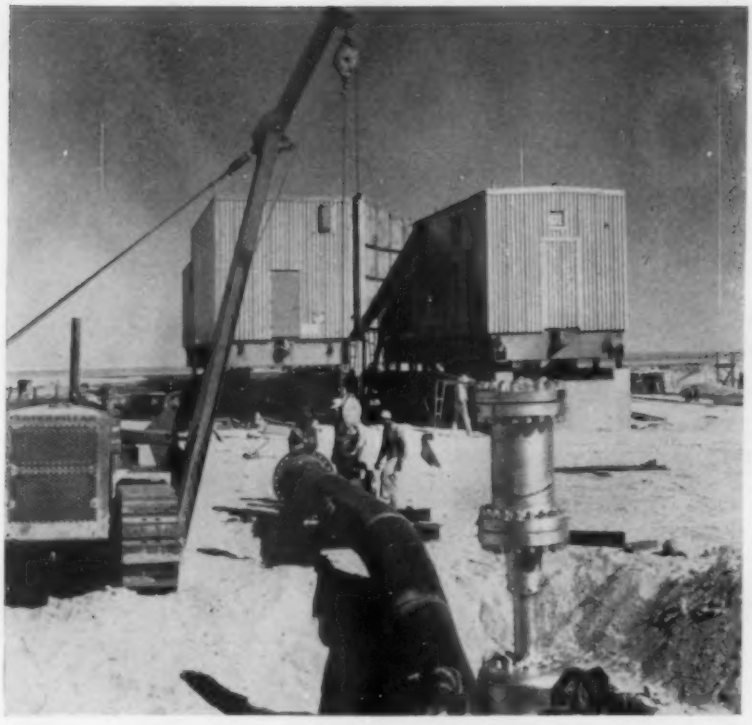
1956—	Western Hemisphere less U.S.	Middle East	Total, non-Communist countries
March	3,467.0	3,623.8	7,711.5
April	3,320.5	3,736.6	7,690.8
May	3,356.5	3,793.9	7,788.1
June	3,519.1	3,713.7	7,871.7
July	3,549.8	3,806.1	7,996.6
August	3,618.2	3,685.8	7,965.6
September	3,637.2	3,721.8	8,019.3
October	3,688.3	3,873.5	8,251.8
November	3,760.8	2,142.8	6,544.2
December	3,915.9	2,428.9	6,989.7
1957—			
January	3,993.9	2,645.7	7,301.7
February	4,040.7	2,855.5	7,561.6
March	4,112.5	2,764.1	7,554.9

Austria May "Free" Plants

Austria is planning to return to private ownership two refineries which have been under state control since the Nazi invasion in 1938.

The government has appointed a committee to oversee details in returning the 4,300-bbl. daily Kagran plant to Socony Mobil Oil Co., Inc., and the 3,400-bbl. Floridsdorf plant to Royal Dutch-Shell.

In addition to the refineries, properties of Rohroelgewinnung, A.G., jointly owned by Royal Dutch and Socony, may be returned. The government also is expected to restore full ownership of Deutsche Gasolin, A.G., a marketing firm in western Austria, to Royal Dutch and a subsidiary of Standard Oil Co. (N. J.).



This first one passed the test so . . .

Aramco's Adding New Turbines

THE FIRST gas-combustion turbine to be installed on the Saudi Arabia-Mediterranean pipeline has passed initial tests and helped increase line capacity to 350,000 bbl. daily.

The 5,000-hp. turbine, first of its kind on a crude or products pipeline, is shown above during installation as an auxiliary pumping unit on permanent foundations at Wariah. This is on Arabian American Oil Co.'s section of the 1,068-mile crude line.

Two other auxiliary units are scheduled to arrive from the United States early in June. Nine turbines were ordered. They are the heart of a program to expand line capacity from 325,000 bbl. to 435,000 bbl. daily *(The Oil and Gas Journal, March 18, page 104).*

The turbine was made possible by the development of temperature-resistant materials for jet engines. Some parts resist temperatures as high as 1,450° F. The turbine itself works on the same principle as a jet power plant.

Crude burned as fuel is treated with an additive, magnesium sulfate. This inhibits the corrosive effects of vanadium in the crude, protecting the turbine blades. Under maximum load, the turbines will use about 430 bbl. of crude daily.

Packaged units . . . The two turbines now en route to the Persian Gulf were packaged at the Bethlehem Shipyards at Quincy, Mass., on 125-ton vans. The vans will be lowered onto heavy trailers, hauled to prepared foundations, skidded onto channels, and jacked up.

Five turbines will be installed as auxiliary pumping units. Two of these will be on Aramco's section of the line. This includes the one already in operation. The remaining three will be on the Trans-Arabian Pipe Line Co. section.

Each auxiliary pumping unit will have three vans in addition to the one housing the turbine. Other vans will house controls, communications equipment, spare parts, and emergency quarters.

A sixth turbine will be used as a spare for the auxiliary units. Two will replace four diesel engines now in use at Turaif pump station. The four diesels will be parcelled out among other permanent pumping stations. All pumping on the line was previously done by diesels.

The ninth unit will be installed in a new permanent pumping station in Jordan. The turbines were built by General Electric and Byron Jackson Pumps, Inc.

Gas Show Surprises Crew at Shallow Core Hole in Libya Desert

A CORE drilling crew is usually content to punch its holes and help geologists map structures for heavier rigs to probe, but a Houston crew simplified procedures a bit.

A Robert H. Ray Co. crew under contract to Mobil Oil Co. of Canada can claim the first spectacular discovery in the search for oil in Libya. The crew was drilling structure holes on a 19,715-sq. km. tract which the Socony Mobil subsidiary has under concession in the Libyan desert in eastern Fezzan.

At 1,510 ft. the bit broke into a high-pressure gas zone and the light mobile rig was in trouble. Members of the crew estimated a flow of 2,000,000 cu. ft. of gas daily along with 2,000 bbl. daily of brackish water from the hole.

It took 127 sacks of cement to kill the flow.

Other operations . . . Last week the rig was drilling another hole in the same area looking for structures and "decent water." Mobil Oil plans a deep test of either the Fezzan tract or another concession in Central Libya for later this year. The well will be drilled by Camdrill International, Inc.

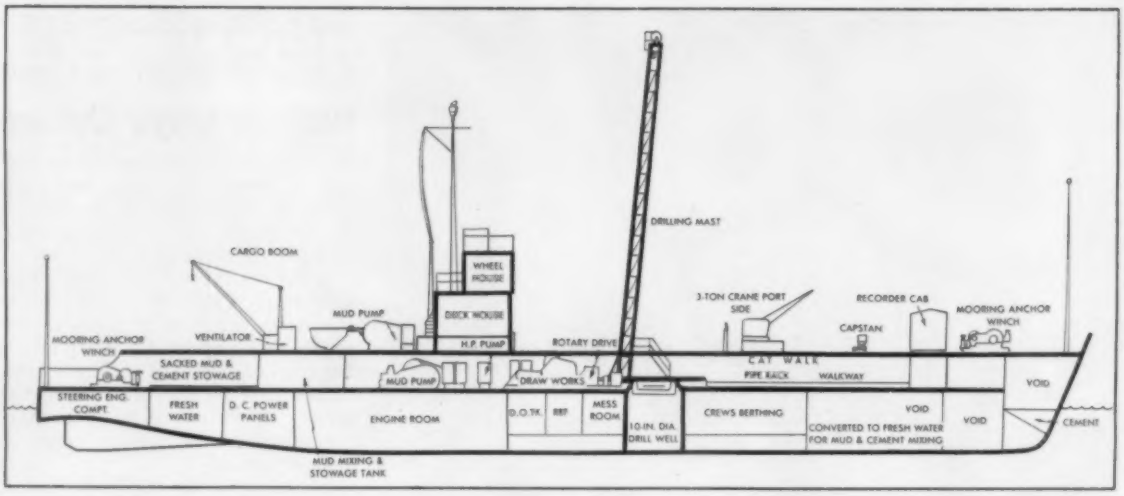
The gas flow found in the structure drilled is the first since Libya started granting exploratory concessions under its new oil law more than a year ago.

The only deep drilling has been done by Libyan American Oil Co. (Texas Gulf Producing Co.) on the Gerdes el Abid uplift in the coastal region of Cyrenaica far to the north. The Libyan American test was abandoned as a dry hole at 9,700 ft. The company spudded a second test 50 miles to the east of the first one in March of this year.

B.P. Stepping up Capacity

Capacity at British Petroleum Co.'s Grangemouth, Scotland, refinery will be increased 20,000 bbl. daily by a new crude distillation unit which is replacing a smaller plant.

The new unit, to cost an estimated $12 million, is due for completion in 1959. It will increase the refinery capacity to 69,000 bbl. per stream day. This added capacity will allow the company to make full use of the 57-mile crude line from the plant to the Finnart tanker terminal at Loch Long on the West Coast of Scotland.



PROFILE VIEW and photo of Richfield's floating drill barge, showing location of principal drilling equipment. Fig. 1.

Improvements have come fast. Here's a picture of

Core-Hole Barges—Vintage 1957

● This floating barge has drilled to 6,000 ft., could go deeper. A television camera keeps watch on operation of ocean-floor control equipment.

By D. H. Stormont
District Editor

EQUIPMENT and techniques for stratigraphic drilling from floating barges have undergone numerous changes since the first barge started work in California coastal waters late in 1955.

Most of these improvements are typified in Richfield Oil Corp.'s "Rincon," a converted LSM (landing ship medium). Placed in operation at the first of 1956, this barge was the second to be outfitted for midship drilling and continuous mud circulation.

... Recent changes and additions made to the 206-ft., 36-ft.-beam barge include an electric-logging unit, and power-driven reels for handling the mud-return line and hydraulic lines. Other additions are a closed-circuit television for viewing the ocean-bottom wellhead equipment and new equipment for handling drilling muds in bulk.

Use of barges . . . Floating barges such as the Rincon have become the principal tool used by California operators in evaluating oil possibilities of that state's submerged lands. No oil wells have been completed. And none will be since purpose of the work is to gain geological information.

DRILLING

Barges equipped for over-the-side drilling have been used for a number of years. But it was only in late 1955 that a barge equipped for center-ship drilling and continuous mud circulation made its appearance.

Eleven barges now are at work in southern California coastal waters, coring and strat drilling much the same as land-based rigs. Three are converted LSM's. One is a 266-ft. converted Y.F.N.B., equipped with a 95-ft. derrick and capable of drilling to 12,000 ft. or deeper with 4½-in. drill pipe. Only one is self-propelled. The others had their propellers removed and must be towed from location to location.

SUBMARINE EQUIPMENT is this assembly consisting of (top to bottom): Funnel to guide drill string back into the hole, air-operated drilling head, mud cross, bag-type blowout preventer, and hydraulic-operated double control gate. Fig. 2.

Limited drilling . . . Most of these barges are drilling on unleased submerged lands. In this work they can drill only to 500 ft. unless they obtain a special permit from the State Lands Commission. With a permit they can core to the "first competent, correlative stratigraphic marker." In cases where thick sections of Pliocene were encountered, this resulted in holes as deep as 4,500 ft.

The Rincon has largely been kept busy on leased submerged lands. Offshore from Rincon field it drilled four holes, including one to 4,200 ft. Based on information gained from the tests Richfield now is building an earth-filled island ½ mile offshore from which development will be carried out.

At Coal Oil Point the barge drilled one hole to about 6,000 ft. As at the deep Rincon hole, pipe was set to test oil possibilities of a potential pay zone found at that depth.

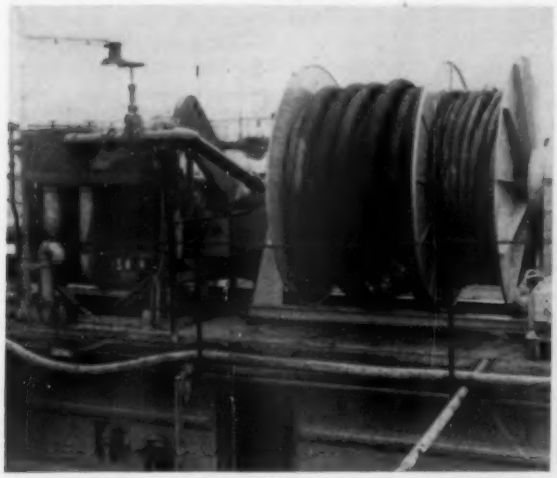
Drilling technique used . . . In floating-barge drilling, wellhead equipment normally directly beneath the derrick floor is set on the ocean bottom. This includes the blowout preventers, a connection by which drilling mud can be returned to the barge, and a drilling head containing a packer which seats around the drill tubing. Controls for the blowout preventers and drilling head are operated from the barge by means of hydraulic lines*

Two guide cables, set after the conductor pipe has been drilled in and cemented, connect the ocean-floor equipment to the barge. These make it possible for the hole to be readily reentered whenever drill tubing is pulled for any reason. A constant-tension drum on the barge keeps the cables taut as the barge rides the swells.

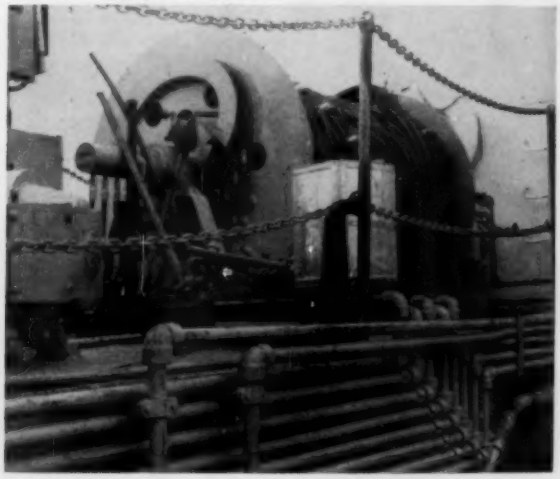
Two other key tools in floating-barge drilling are those for connecting and disconnecting the drill string to the ocean-floor drill head. For attaching the wire-line guides, a Shaffer single-ram control gate is used. It seats in a locking groove provided in a nipple which extends above the conductor pipe. Hydraulic controls operated from the barge seat and unseat the rams.

The other is a right-hand-torque releasing safety joint. As explained

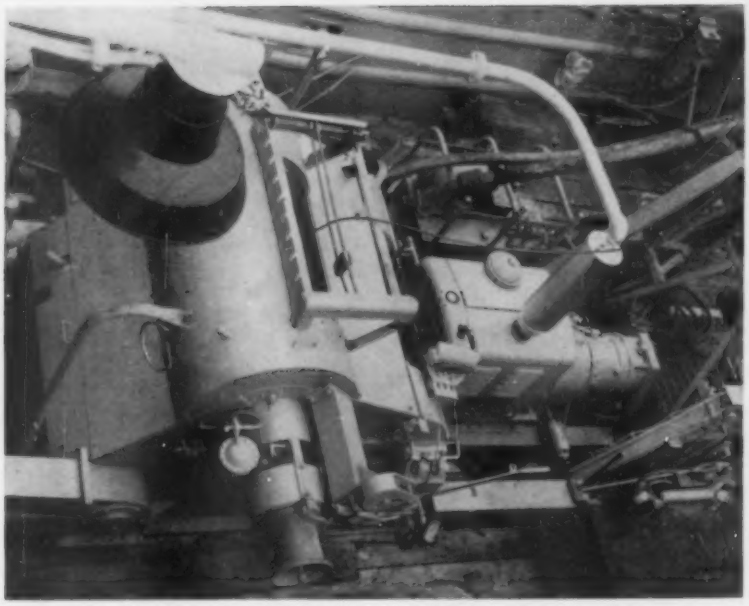
*The Oil and Gas Journal, February 27, 1956, page 130.



POWER-OPERATED reel for handling the 4-in. mud return and 2-in. fillup lines. Fig. 3.



REEL for handling hydraulic and air lines which make possible remote operation of subsea equipment. Fig. 4.



DRAW WORKS and rotary drive, diesel-engine driven, both use torque converters in the power train. That in the hoist helps to keep the bit on bottom as the barge rises and falls with the waves. Fig. 5.

later, this tool provides the means for freeing the drill tubing from the conductor pipe after the latter is cemented. It also is used to engage (and diconnect) the blowout-preventer assembly to the subsea wellhead.

... Setting conductor pipe is the first step. In this operation the desired length of 10¾-in. casing (usually some 30 or 40 ft.) is made up and suspended in the 10-ft.-diameter well through which drilling is carried out. The right-hand torque safety joint is placed on top of the casing, and then a crossover sub to reduce the size to that of the 2⅞-in. drill tubing. One or more oil-sealed bumper subs, to assist in overcoming wave action, are then added before the drill string is run to bottom.

Using the casing as drill pipe, it is jetted and drilled down until a depth-control spider attached to the safety joint is flush with the ocean floor. Pipe then is cemented, using standard cementing practices similar to those followed on land-based rigs.

Before the safety joint is released for subsequent drilling operations, the guide cable assembly is run. The single-ram control gate attached to the lower end of the lines is stripped over the drill pipe and lowered to bottom. After it is properly positioned, the hydraulic controls are operated to seat the rams.

The safety joint then is unlocked by dropping a releasing rod down the tubing. By rotating the drill string a fraction of a turn to the right the barrel of the safety joint can be pulled up with the drill string, leaving the mandrel in place.

With the pipe pulled, the blowout preventer and drilling-head assembly are made up and run to bottom. The assembly, from bottom to top, consists of the barrel of the safety joint, a hydraulic double control gate, the cross for the mud-return and fillup line, a bag-type blowout preventer, and the submarine drilling head. Arms at the top and bottom of this assembly provide the means for attaching the assembly to the guide cables.

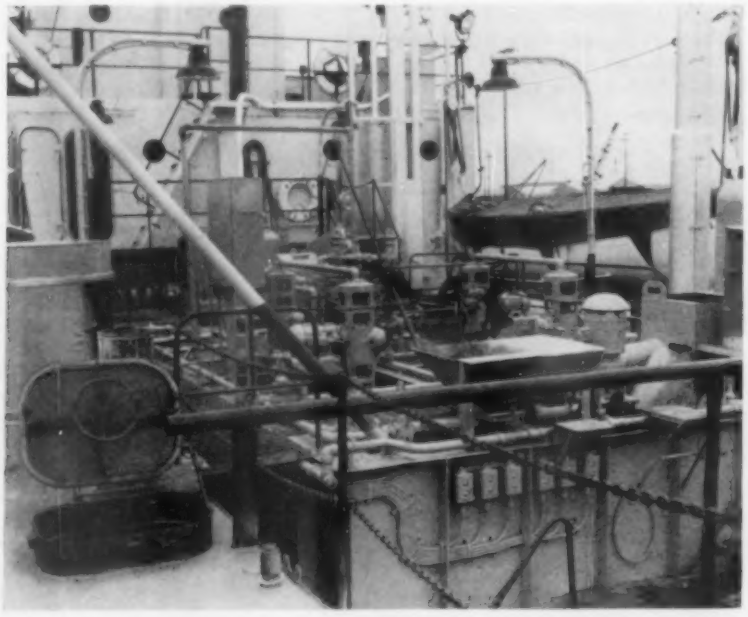
... During the drilling of the core hole a packer in the submarine head provides the means for sealing around the drill string, keeping ocean water out of the hole and drilling mud confined to the hole. The double control gate, with its hydraulic controls centralized at the driller's post, provides a secondary seal for packing off around the drill string.

The control gate also provides the means for removing the drill string from the hole whenever this is necessary for any reason. In this operation the bit is raised until it is positioned between the drilling head and the control gate. The blind rams then are closed, sealing off the hole after the pipe has been pulled. With these closed, the packer in the drilling head then is released, permitting the drill string to be pulled.

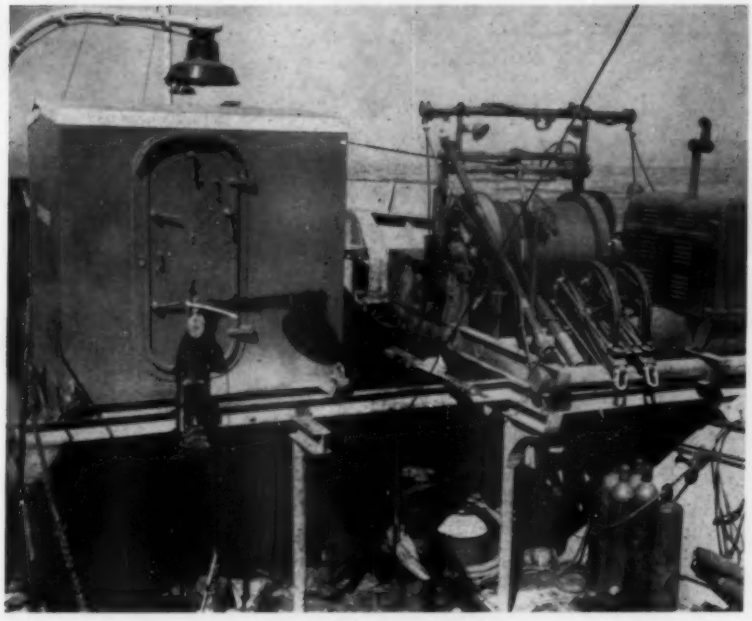
In early work a sleeve-type rotating packer was used to seal off the drill tubing while drilling was in progress. This did not prove too successful. Abrasive wear and tear from the tool joints passing through the packer soon destroyed the seal.

Now a 10-in.-opening bag-type preventer, equipped with 7-in. wear sleeve, is used. The 10-in. opening allows easy passage of tool joints and 7⅝-in. bits. Air up to 500 psi. pressure is available for collapsing the packer around the tubing while drilling is in progress.

In shallow core drilling—up to 500



MUD MIXING and storage tanks aboard the Rincon. A new bulk mud system and screw conveyor is now installed adjacent to the tanks. Fig. 6.



NEW ELECTRIC logging equipment permits core holes to be logged at will. No longer is it necessary for a unit to be barged out from land. Fig. 7.

ft. for example—the conductor pipe is the only casing set. In its deeper tests Richfield also set and cemented several hundred feet of 8⅝-in. surface pipe to assure that the tests could always be kept under control.

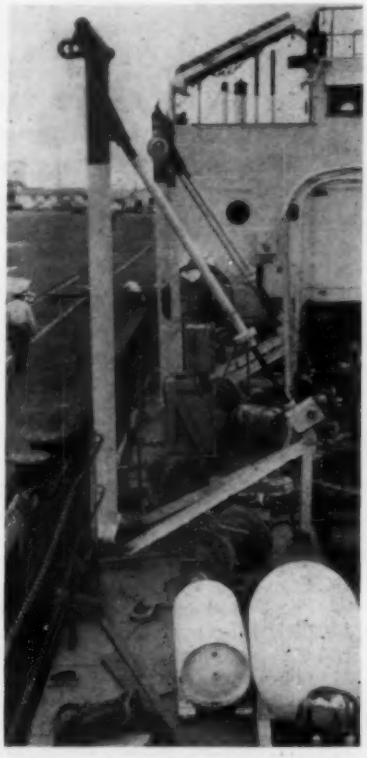
Additions to Barge Equipment

A 6¾ by 12-in. pump powered by a 180-hp. diesel engine originally was used for circulating mud. This was adequate for drilling small core holes to shallow depths but was insufficient for deeper drilling. Thus a second pump, 7½ by 14 in. and powered by a 300-hp. diesel, was added.

Reel . . . For handling the long lengths of mud-return line required when the barge is working in fairly deep waters, a powered reel was installed adjacent to the shale shaker. Some 300 ft. of 4-in. (2,500-psi. test) hose can be stored on the reel, as well as a similar length of 2-in. fill-up line. The reel is driven through gears by a 3-hp. motor.

A similar reel also was installed for handling the 10 hydraulic lines used for operating the ocean-floor drilling controls. These ½-in. i.d. lines (5,000-psi. test) are all tied together with the air line which leads to the drilling head. Steel lines connect the hose to the control panel placed near the driller's post.

Rotary . . . Another change in drilling equipment was in the rotary drive. This was originally powered by a 50-hp., high-torque electric motor. Because it could not deliver the desired torque it has been replaced by a 100-hp. diesel engine. A torque converter also was incorporated in the rotary-table drive.



DAVIT and winches in foreground now handle a new closed-circuit television system which permits ready viewing of the ocean-floor drilling equipment. Fig. 8.

"Core holes thus can now be logged at any time. It is not necessary to wait while a truck is being barged out from land."

Mud . . . Heretofore drilling muds have been handled in sacks. On the Rincon's last trip into port a bulk mud system was installed. A 12-in.-diameter screw conveyor, powered by a 3-hp. motor, transfers mud materials to the mixing hopper.

Two storage bins have been placed on the main deck, immediately in rear of the mud tanks. A 9 by 10½ by 12-ft. bin is used for clay and a 10½ by 5 by 12-ft. bin for barites. Chemicals are still handled in sacks.

For hauling mud materials to the barge, 45-cu.-ft. steel canisters are used. An 8-ton crane handles the canisters.

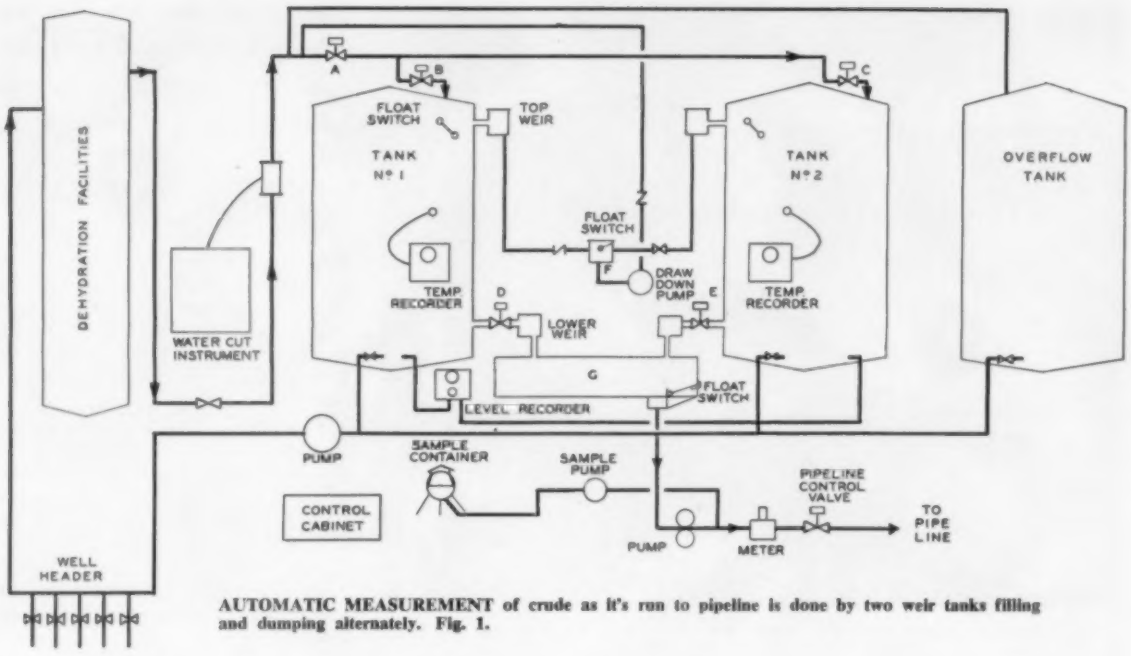
Logging . . . A Schlumberger electric-logging unit was another recent addition to the barge. Core holes thus can now be logged at any time. It is not necessary to wait while a truck is being barged out from land.

Television . . . The recently installed closed-circuit television system permits ready viewing of the ocean-bottom drilling controls. Enclosed in a waterproof housing, the camera is lowered on guide lines to the ocean floor. The condition of drilling equipment is viewed on a 10-in. screen. Remote controls adjust the lens iris and focus adjustments for variations in lighting and subject distance.

The under-water viewing system should be most useful for determining what is wrong when a breakdown occurs. For example, the remote-operated single gate may not seat properly on the casing landing nipple, or for some reason or other trouble may be experienced in reentering the hole after a bit change. In such cases in the past, it has been necessary to halt activity until a diver could go down.

A boom for handling the guide lines on which the camera housing operates is installed opposite the rotary table. The guide lines, handled by air-operated winches, will be connected to the stabilizing lines on which the underwater drilling assembly operates.

Another change to be made on the Rincon is in the drill tubing. A new string now on order will be 2⅞ in., with 3½-in. o.d., full-hole tool joints.



AUTOMATIC MEASUREMENT of crude as it's run to pipeline is done by two weir tanks filling and dumping alternately. **Fig. 1.**

Now on trial use after 9 years' development, here's

How Shell's Antelope L.A.C.T. Works

The Texas Railroad Commission has granted Shell Oil Co. permission to try its automatic-custody-transfer battery at Antelope. Although Shell began only recently to pump oil automatically from Antelope field to pipeline, first tests of the idea began there 9 years ago. In fact, much of the equipment now in use was installed at that time. Over those 9 years, Shell has evolved an accurate, reliable, trouble-free, and potentially money-saving system.

By Ed McGhee
District Editor

ON AN average day, more than 300 bbl. of crude oil passes to Sinclair Pipe Line Co. from Shell Oil Co.'s H. Henderson lease in Antelope field of Clay County, Texas. Yet, the pumper doesn't catch samples, gage the tanks, nor measure temperature. It's all automatic. This is lease automatic custody transfer (L.A.T.C.).

Shell finds the L.A.C.T. system helps conserve the gravity of the crude oil—it's about 0.2° A.P.I. higher than when the battery was manually operated. This gravity increase doesn't mean much in crude price, but it does mean that some 32 bbl. of oil no longer escapes to atmosphere each month.

Moreover, there's a capital-cost saving in such a system. On a lease like the Henderson, an investment of $10,000 is enough to install the L.A.C.T. and allow salvage of about $13,000 of conventional equipment. When installing a new battery on such a lease, Shell estimates an L.A.C.T. system would be $9,000 cheaper than an ordinary battery.

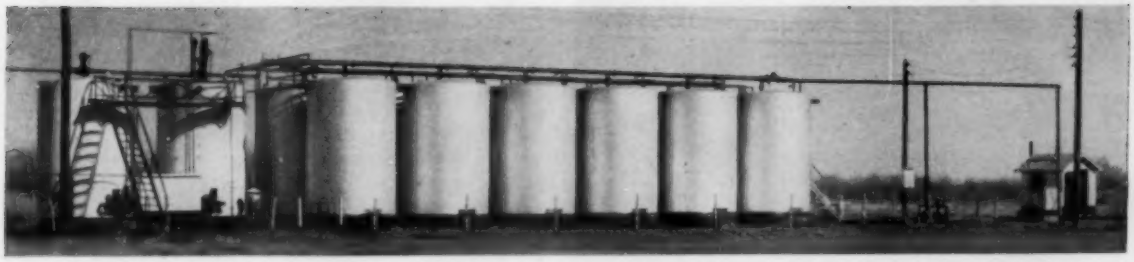
PRODUCING

An automatic system like this is cheaper to operate. It leaves the pumper more time to do jobs that make his wells produce more efficiently—jobs he might not have time for if kept too busy gaging, sampling, and the like.

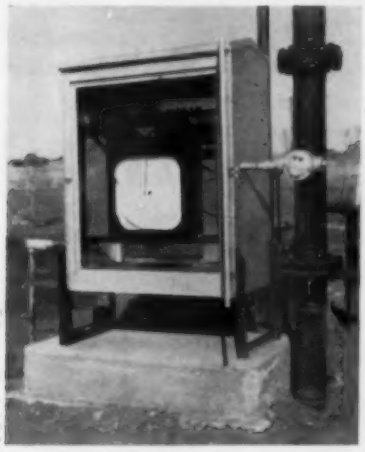
Two-tank system . . . Fig. 1 shows the layout of the Henderson automatic system. Briefly, there are two tanks with overflow weirs to control top and bottom levels. When pumping starts, oil in the tank is level with the top weir, it pumps out to the level of the bottom weir. Since the weirs are fixed to the side of the tank, opening and closing gages are always the same. Thus, each time a tank pumps out, the same, known volume goes to pipeline.

While oil is being pumped out of the weir tank, automatic instruments record the temperature and collect a sample for gravity and b.s. and w. measurement. To figure the amount of oil sold requires only recording the number of times each tank dumps and correcting for temperature and b.s. and w.

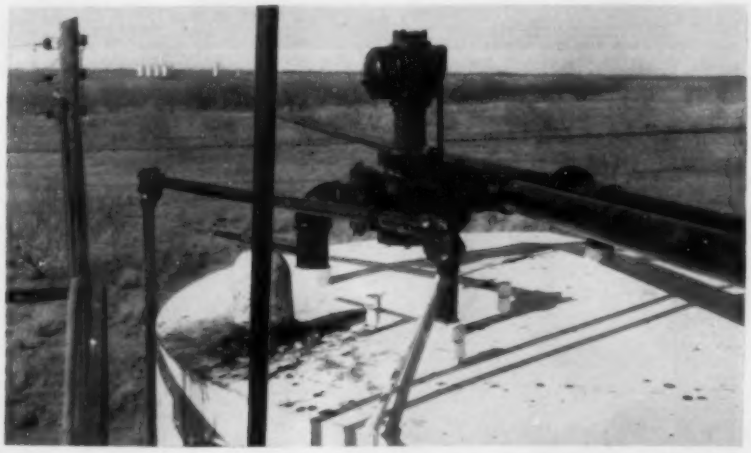
Sequence of operation . . . Oil flows from the well header into a heater-treater. The line out of the treater



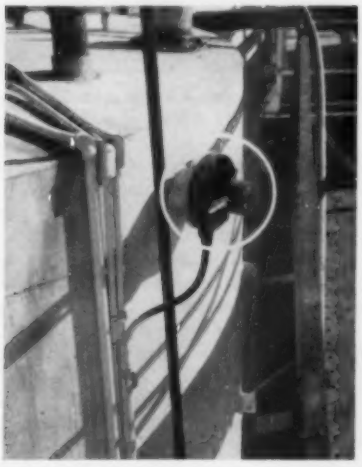
BATTERY consists of the two weir tanks on the left and overflow tanks. Heater-treater is on the right out of photo. Fig. 2.



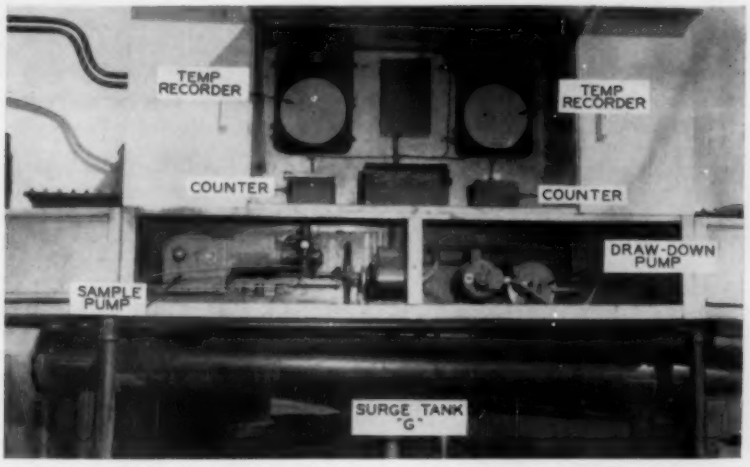
WATER CUT is monitored as crude leaves treater. Fig. 3.



FILL VALVE opens when tank is emptied and receives crude passing water-cut monitor. Fig. 4.



FLOAT SWITCH stops filling when tank is full. Fig. 5.



DISCHARGE OF OIL follows topping of tank by drawdown pump. Temperature and sample are taken automatically. Fig. 6.

carries a water-cut instrument (Fig. 3) which controls valve A in Fig. 1. When oil is of pipeline quality, valve A is held open and the oil flows through valve B (Fig. 4) into tank 1. When tank 1 is full, a float switch (Fig. 5) closes valve B, and opens valve C. This starts tank 2 filling.

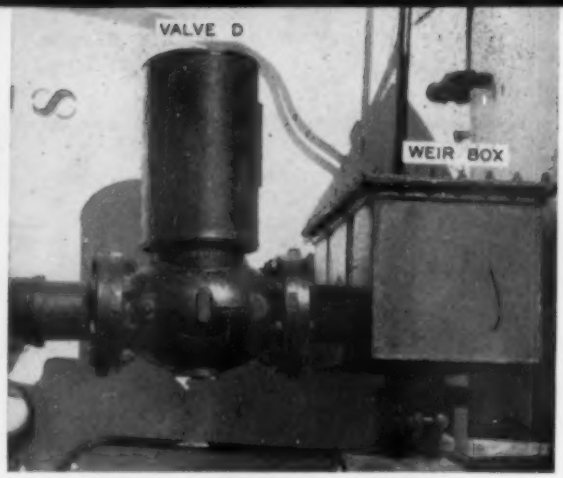
A time-delay relay in the control cabinet (Fig. 6) lets the oil in tank weather, the time set from 15 minutes to 2 hours or more as required. Next, the drawdown pump (Fig. 6) starts pumping the oil down to the level of the top weir (Fig. 7). When float chamber F is empty, the float switch in the drawdown line stops the pump and starts to open valve D (Fig. 8).

As soon as valve D is wide open, the pipeline pump (Fig. 9) starts. Also, a sample pump (Fig. 6) starts and collects a proportionate sample as long as oil is pumped to pipeline. The electrically operated temperature recorder (Fig. 6) operates during this custody transfer.

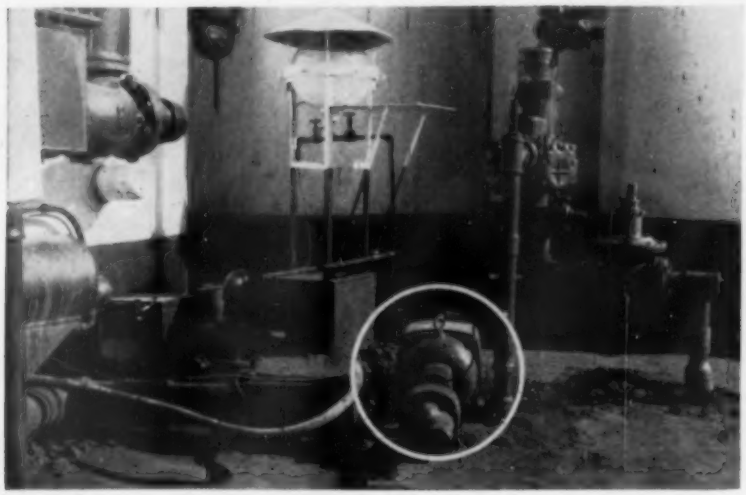
After the oil in tank 1 is down to the lower weir level (Fig. 8) and the surge tank G (Fig. 6) is pumped out, the float switch in surge tank G shuts down both the pipeline and sample pumps. Valve D closes. Now, tank 1 is ready for use as soon as tank 2 is full. When tank 2 fills, the sequence of operation is the same as for tank 1.

If the water-cut instrument detects

WEIR BOXES are external to tanks, provide accurate gages of level. Fig. 7.



DISCHARGE VALVE from tank opens to weir box which gages emptied level. Fig. 8.



PIPELINE PUMP draws oil from surge tank as tank discharge valve opens. Pump is shut down by float switch in surge tank. Fig. 9.

TANK-BOTTOMS VALVE is sealed to insure accurate oil delivery. Fig. 10.

bad oil, it closes valve A so that oil switches into overflow tank 3. Wet oil in tank 3 can be circulated through the heater-treater later.

Agrees with hand methods . . . The weir-tank system at Antelope has operated without significant changes in equipment since February 1956. For the first 6 months after that, oil from the L.A.C.T. system was not pumped direct to pipeline. It went first to a conventional battery on the same location. There, it was hand gaged and hand sampled to check the automatic measurements before transfer to the pipeline.

Over that 6-month period of double checking, the automatic equipment showed accuracy and dependability equal to, or better than, conventional practices. In a typical 2-week period, the L.A.C.T. system showed a volume of 6,226.67 bbl. of oil pumped out. During that same time, the conventional hand methods showed a volume of 6,224.37 bbl. This difference of 2.30 bbl. is only 0.037 per cent.

After the L.A.C.T. system began to pump direct to pipeline, Shell ran further checks to make certain the measurements still agreed with conventional measurements. For 2 weeks, each tank was gaged with a hand line before and after it was pumped out. There was never any measureable difference in the opening and closing as established by the weirs.

During the same 2 weeks, the average temperature recorded automatically was 92.5° F. Hand measurements for 33 runs in that period averaged 92.3° F.

The four composite samples taken during the 2-week check averaged 42.7° A.P.I. gravity and 0.23 per cent b.s. and w. Hand-caught samples for 37 runs in the same time showed an average of 42.8° A.P.I. and 0.24 per cent b.s. and w.

Protects pipeline, producer . . . The Antelope L.A.C.T. has several checks on the number of tanks of oil pumped to pipeline. In the electric-control system there is a counter for each weir tank. There is also an overriding "predetermined" counter which keeps the lease from over running its allowable. The number of tanks that can be run without exceeding the lease allowable is predetermined, and this number is set on the counter. Then, when this number of tanks has been run, the counter shuts down the battery until it is reset for the next month.

Besides these counters, Shell has put a liquid-level recorder on each tank as a further check on the number of tanks run. Connection to the liquid-level elements is near the bottom of the tank so that it will give a continuous record of the head of fluid in the tank.

Weir-tank bottoms will be pumped out regularly to prevent a buildup of sediments. However, to make certain this doesn't happen at a time that would interfere with accurate measurement by the L.A.C.T. system, the bottom valve has an electric interlock. Moreover, there is a seal in the valve (Fig. 10); this will be removed only when representatives of both pipeline and producer are present. **End.**

BLITZING ALKYLATION PROBLEMS—5

Tips on Handling Unit Charge

The feed streams to alkylation units can vary widely. Propylene, mixed butenes, and mixed pentenes may be combined in various proportions in the olefin charge, and isobutane-butane ratio varies also. Here are tips on solving some of these feed problems.

By Larry Resen
District Editor

Problem: How to Operate With Amylene Charge And to Reduce Turnaround Down Time

Solution: Add deisopentanizer and use piecemeal turnaround procedure.

Discussion: In charging amylenes to an alkylation unit, a problem was faced by the operators due to vapor pressure of the alkylate, which was limiting throughput in the unit. The particular unit included an old jet reactor and a new cascade reactor which was installed as a part of an expansion program.

The plant was alkylating butylenes and some amylenes, with the throughput limited as above. This limitation was compounded by the fact that amylene charge included isopentane which increased the vapor-pressure problem.

The decision was made to install a deisopentanizer downstream of the debutanizer and upstream of the rerun tower. With this installation, the bottleneck was eliminated, with high-vapor-pressure isopentane removed in this step. A compounded benefit was gained here, for in addition to the increased alkylate being produced, isopentane was being received as an ideal blending stock.

Amylene variation . . . Present operation finds amylene content of olefin feed to vary between 15-20 per cent. Olefin content of charge amounts to 28.4 per cent of the total feed and isopentane amounts to 13 per cent of the total feed. Total feed to the unit is split between the two reactors, with the effluent from the first (jet reactor) fed into the second reactor.

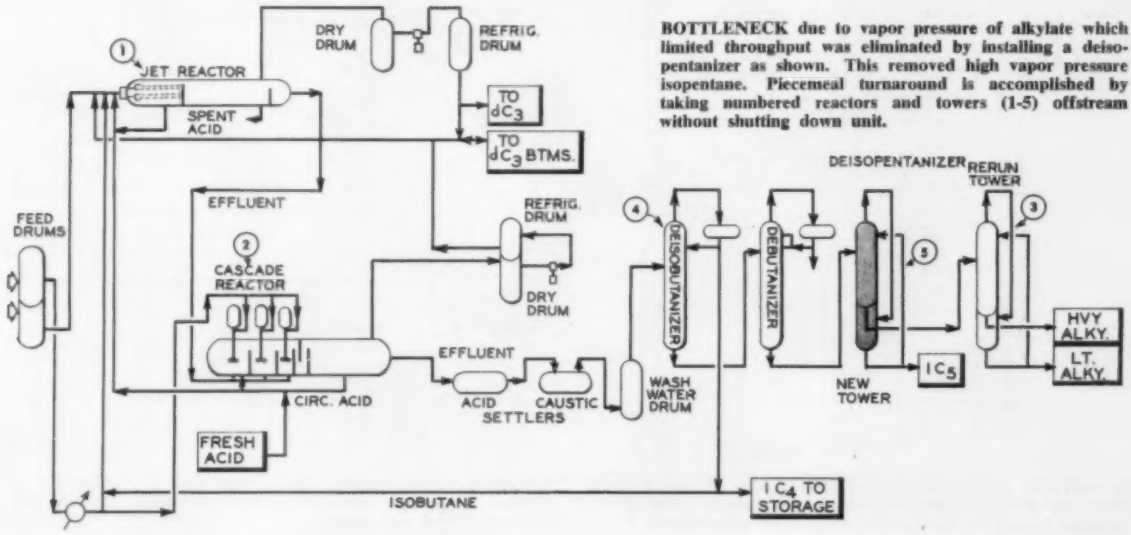
On the basis of 6,100 bbl. of total feed, about 2,700 is fed to the first reactor, and 3,400 split evenly in the three zones of the second reactor. Isobutane is added to feed into both units to provide an external iso/olefin ratio of 18:1 on the first reactor and 14:1 on the second reactor.

Total alkylate production under these conditions amounts to 2,940 bbl., equivalent to 1.7 bbl. of alkylate per bbl. of mixed olefin charge. Light alkylate amounts to an average of 93 per cent of this total yield. The light alky has an F-3 number of 121.5 and an F-4 number of 148 with an R.v.p. of 4.5. Isopentane yield amounts to about 650 bbl.

Turnaround . . . A piecemeal shutdown routine is practiced on this unit which takes advantage of the two reactors available. This enables the entire unit to undergo a turnaround with it being totally shut down only during the time the deisobutanizer and the debutanizer are being inspected or worked on. Under normal conditions, these towers function without undue wear or corrosion, and a rapid inspection is about all that's required.

The reactors are equipped with bypass arrangements. Initially one is taken out of service with the unit operating at reduced throughput on the second. Next, the other one is pulled off the line and the unit continues to operate at a reduced rate on the first.

The rerun tower is taken out of service and total alkylate diverted to storage. Once this tower is placed back on stream, the temporarily stored alkylate is gradually feed into the rerun tower along with the unit make. The depentanizer is a new tower, but during the piecemeal shutdown, it can be pulled offstream and the amylene charge somewhat reduced. The debutanizer bottoms can then be fed directly to the rerun tower until the de-



BOTTLENECK due to vapor pressure of alkylate which limited throughput was eliminated by installing a deisopentanizer as shown. This removed high vapor pressure isopentane. Piecemeal turnaround is accomplished by taking numbered reactors and towers (1-5) offstream without shutting down unit.

isopentanizer is brought back on stream.

With this system in operation, the required standby B-B storage is held to an absolute minimum. The reduced feed rate enables most of the olefins to be processed, and also insures a continuing supply of alkylate during the turnaround period.

Problem: How to Handle Increased C_3 Charge

Solution: Revamp refrigeration system.

Discussion: In the original alkylation unit distillation train, reactor effluent was charged to the unit debutanizer. Alkylate was pulled off the bottom and overhead passed through a depropanizer and deisobutanizer. Under routine operating conditions this situation was satisfactory.

With expansion of other refinery units, additional propane-propylene became available for charge to the alkylation unit, and it was desirable to take advantage of this feed source. Presence of propane in the refrigeration system causes the buildup of a high discharge pressure, thereby limiting compressor capacity, and in turn limiting refrigeration capacity and unit throughput.

The change was made to pull the depropanizer out of the alkylate distillation train and use it to depropanize the refrigeration cycle liquids. A flow controller is tied in downstream of the liquid accumulator in the cycle and controls charge rate to the depropanizer where propane is withdrawn overhead and depropanizer bottoms are circulated to the reactors. The accumulator is also equipped with a level controller to maintain proper balance. Refrigerant liquid in excess of the depropanizer's capacity is recycled to the reactors.

With this system the propane concentration is reduced, the compressors are thereby unloaded since the discharge pressure is much lower, and the refrigeration capacity is increased. This change made it possible to triple the amount of propane-propylene which could be processed over and above the same B-B charge, and also made it possible to increase the B-B charge.

Problem: Converting Alky Feed-Prep Unit

Solution: Improve water wash system; add acid water stripper.

Discussion: In treating a propane-propylene feed for an alkylation unit, the stream is charged to a Girbotol unit for removal of H_2S. The hydrogen sulfide is directed to the acid plant and the decontaminated feed is caustic washed and then charged to the alkylation unit. In order to avoid contaminating the diethanol amine solution in the treating unit, the P-P charge is first water-washed for removal of cyanides.

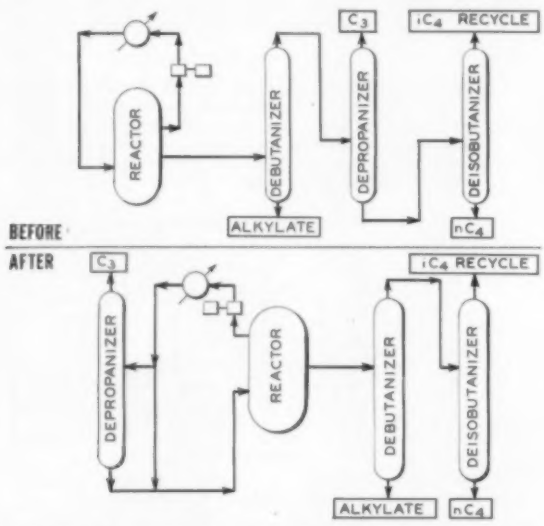
Originally, two small vertical drums were used to settle out the water. The P-P charge was carried overhead from the drums to the Girbotol unit and the water from the bottom was drawn off to an accumulator and depressured. From here gas went to the flare system and water to the sewer.

In operating this unit, the vertical drums experienced a buildup of a "rag" interface, which carried over into the treating unit and caused fouling of the absorber. Additionally, the drums were too small to settle sufficient water as the throughput of the unit was gradually increased. Finally, the water being discharged into the sewers contained some H_2S as did the gas being flared off the depressuring drum.

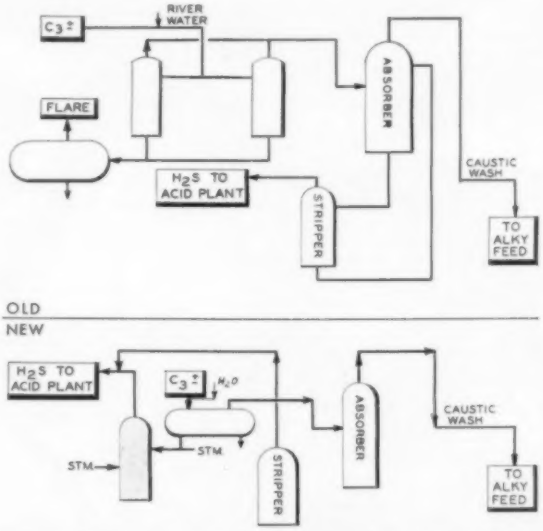
Modifications . . . Several modifications were made to improve the situation. The vertical drums were taken out of service and replaced with a large capacity horizontal drum. This drum was equipped with a baffle over which the rag was gradually withdrawn. In this manner, additional volumes of feed could be handled and the possibility of the rag building up and carrying over into the absorber was eliminated. One of the old vertical drums was packed with Raschig rings, and water from the settling drum was charged to this vessel which acts as a stripper.

Steam was injected in the base of the drum and also along with the water feed. The residual H_2S was stripped out in this manner and the deodorized water was then disposed of in the sewer system. Overhead gas from the stripper was added to the H_2S removed in the Girbotol unit and charged to the acid plant.

These modifications have resulted in improved operation of the treating plant, a cleaner feed, less contaminants to affect the DEA solution, and the removal of objectionable odors from the sewer system.



IN FORMER arrangement reactor effluent was charged to debutanizer and debutanizer overhead went to depropanizer. Now the latter tower is used to depropanize refrigeration cycle liquids.



ORIGINALLY two vertical drums were used in settling out of cyanides. These were replaced by a horizontal drum. Residual H_2S was stripped out with steam.

Cat Cracking With Kaolin Catalyst

. . . 4 advantages over bentonite clay
. . . 2 advantages over synthetic
. . . 3 advantages over bentonite *and* synthetic

By D. Beyler, J. D. Maerker, and J. W. Schall

THE COMMERCIAL use of kaolin has these advantages over bentonite clay catalyst.

- F-1 clear or leaded octane rating of the gasoline is substantially higher at constant operating conditions. Gasoline yield is the same or higher.
- Coke yield is lower.
- Catalyst breakage is lower.
- High-sulfur stocks can be processed.

The commercial use of kaolin has these advantages over synthetic catalyst.

- Gasoline yield is higher.
- Daily catalyst costs are substantially lower because of lower cost per ton together with the same or lower makeup rate.

Kaolin has these advantages over both bentonite and synthetic catalysts.

- Kaolin is much more stable toward steam and temperature deactivation.
- Instantaneous carbon burning rates are much higher. Consequently, in any unit which is limited in coke-burning capacity by kiln volume, the use of kaolin will increase the coke-burning capacity substantially.
- Equilibrium unit activity is higher. Therefore, charge rate can be increased and conversion level maintained constant or conversion level can be increased at constant charge rate.

Pelleted-kaolin cracking catalyst is now being marketed and is being used in a number of commercial units. It currently supplies in excess of 25 per cent of the total moving bed cracking catalyst requirements.

What it is . . . Kaolin is a naturally occurring clay which contains approximately 45 weight per cent alumina (as Al_2O_3), as shown in Table 1. Silica constitutes the only other major component of kaolin. A typical analysis of kaolin is shown in Table 1 on an ignited basis. The kaolin deposits which are used as a catalyst source are extensive and very consistent in composition.

TABLE 1—TYPICAL ANALYSIS OF KAOLIN CRACKING CATALYST

Component—	Weight per cent, ignited basis
Al_2O_3	45.0
SiO_2	53.0
Fe_2O_3	0.3
Other oxides	1.7
Total	100.0

Kaolin, in its natural state, is not sufficiently active to be used as a catalyst for cracking petroleum stocks. However, by means of appropriate processing steps which were developed jointly by Houdry Process Corp. and Minerals & Chemicals Corp. of America, kaolin is brought to the desired high activity level with excellent characteristics as a cracking catalyst.

Authors are with Houdry Process Corp., Philadelphia. Paper presented at W.P.R.A. meeting, San Antonio.

REFINING

The physical and cracking characteristics of bentonite clay and synthetic type of catalysts are well established by years of laboratory and commercial usage. The limitations of these catalysts for moving bed catalytic cracking purposes are also well established.

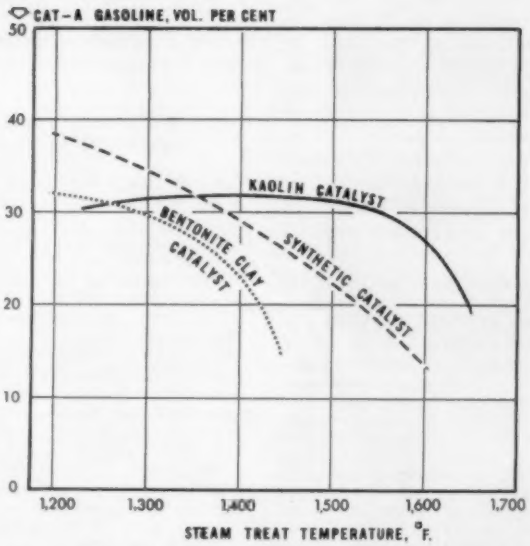
The classical limitations of bentonite clay for catalytic cracking are as follows: (1) subject to sulfur poisoning, (2) relatively low gasoline octane level, (3) limited steam and temperature stability, and (4) limited unit activity.

Similar limitations of synthetic type of catalysts are: (1) limited steam and temperature stability, (2) limited unit activity, and (3) difficulty of regeneration.

Kaolin catalyst overcomes all of these limitations to a large extent:

Steam and Thermal Stability

The steam and thermal stability of kaolin catalyst compared with bentonite and synthetic types of catalysts



STEAM-THERMAL stability of kaolin, synthetic, and bentonitic-type catalysts. Basis: 4 hours at temperature in 1 atm. abs. steam. Fig. 1.

is shown in Fig. 1. In these accelerated aging tests, the catalysts were held at the depicted temperature for 4 hours in 1 atm. absolute of steam. Following this the catalysts were subjected to the standard laboratory Cat-A activity tests.

Fig. 1 presents the Cat-A gasoline yield as a function of steam-treat temperature. Kaolin catalyst maintains its Cat-A activity up to a temperature in excess of 1,550° F. before showing any marked deactivation. Bentonite and synthetic types of catalysts, on the other hand, show rapid deactivation at temperatures well below 1,400°-1,500° F.

In terms of commercial operation this means that: (1) in units utilizing kaolin catalyst, kilns can be operated at temperature levels substantially in excess of those using bentonite and synthetic types of catalysts without fear of steam-thermal deactivation; or (2) a higher unit activity can be maintained when using kaolin catalyst.

The higher temperature stability is of particular importance in the case of kilns with limited coke-burning capacity and in case of unavoidable temperature upsets.

Kaolin catalyst can be used equally well in the cracking of sweet or very sour stocks. It is very similar to synthetic catalyst in that it is not deactivated or poisoned by sulfur compounds.

Regenerability . . . Regeneration characteristics of the subject catalysts are present in Table 2. Laboratory-determined carbon-burning-rate constants are shown for regeneration temperatures of 850°, 1,000°, and 1,100° F. The rate of carbon burnoff from catalyst is proportional to the burning-rate constant. Thus, the data of Table 2 show that kaolin exhibits substantially higher carbon-burning rates than either bentonite clay or synthetic types of catalysts.

The increased regenerability of kaolin catalyst is of particular importance in the case of commercial kilns which are limited in coke-burning capacity because of volume limitations when using bentonite or synthetic catalysts.

The use of kaolin catalyst in such a unit results in increased kiln coke-burning capacity, which in turn permits either higher gas-oil charge rates or greater depth of cracking.

The outstanding regeneration characteristics of kaolin have been attested by commercial experience in units containing a mixture of kaolin and bentonite clay and/or synthetic catalysts. In cases where coke burnoff has been incomplete, the kaolin catalyst in the mixture contains considerably less residual carbon than either the bentonite clay or synthetic catalysts.

TABLE 2—REGENERATION CHARACTERISTICS OF KAOLIN, BENTONITE AND SYNTHETIC TYPES OF CATALYSTS

	Carbon burning-rate constant, Sec.$^{-1}$ × 10^{3}*		
Temperature, °F.	850	1,000	1,100
Catalyst:			
Kaolin	0.26	2.8	5.8
Bentonite clay	0.21	1.6	2.8
Synthetic	0.18	1.3	2.5

*The rate of coke burnoff from catalyst at an oxygen partial pressure of 0.21 atm. is proportional to the carbon burning-rate constant.

TABLE 3—TYPICAL COMPARISON OF KAOLIN WITH BENTONITE CLAY CATALYST PILOT-PLANT OPERATION

(Charge stock: gas oil from East Texas crude)

Operating conditions:	Kaolin	Bentonite clay
Temp., °F.	900	900
Cat/oil ratio, W/W	4.5	4.5
Space rate, V/H/V	1.8	1.0
Yields:		
Conversion, vol. per cent	50.0	50.0
Gaso., 385° F. at 90 per cent, vol. per cent	38.2	40.7
Total C_4 cut, vol. per cent	12.2	10.2
nC_4, vol. per cent	1.1	1.1
iC_4, vol. per cent	5.1	4.1
C_4=, vol. per cent	6.0	5.0
Total C_3 cut, vol. per cent	7.0	6.2
Sat. C_3, vol. per cent	1.8	1.8
Unsat. C_3, vol. per cent	5.2	4.4
C_2 and lighter, wt. per cent	1.9	1.9
Coke, wt. per cent	3.6	3.8
Gasoline octanes:		
F-1 clear	92.7	89.7
F-1 + 3 cc. TEL	98.6	96.5

Kaolin vs. Bentonite Catalysts

Pilot plant data comparing typical cracking characteristics of kaolin catalyst and an equilibrium bentonite clay catalyst are shown in Table 3 for cracking a sweet-gas oil at a conversion of 50 volume per cent. All operating conditions were the same for both catalysts with the exception of the space rate. Space rate was varied to give the desired conversion level. Important aspects of the comparative data presented in Table 3 are:

1. Kaolin has a considerably higher unit activity than bentonite clay. At otherwise constant reactor conditions, kaolin gives the same conversion level at a much higher space rate than bentonite clay.

2. Although the direct gasoline yield obtained by kaolin is indicated to be less than that obtained from bentonite clay at the same conversion level, the ultimate gasoline yield available by supplementary alkylation and polymerization processes is approximately the same for kaolin and bentonite. This results from increased yields of isobutane, and C_3 and C_4 unsaturates from kaolin.

3. Kaolin gives slightly less coke than bentonite clay.

4. Kaolin yields a gasoline with an octane level approximately three numbers (F-1 clear) higher than produced with bentonite clay at equivalent reactor temperature conditions.

5. Kaolin will give the same gasoline octane rating as bentonite clay at approximately 40°-50° F. lower reactor temperature. Since, in catalytic cracking, the gasoline yield increases as reactor temperature decreases at constant conversion, the same or higher gasoline yield will be obtained with kaolin as with bentonite clay at constant octane.

This demonstrates the great flexibility available to the refiner with kaolin catalyst. Operation can be adjusted to maximize gasoline yield or

TABLE 4—COMMERCIAL KAOLIN CATALYST OPERATION COMPARISON WITH BENTONITE CLAY—LEONARD REFINERIES, INC., ALMA, MICH.

	Before kaolin Sept.-Oct. 1955	After kaolin Sept. Nov. 1956
Kaolin in unit catalyst, wt. per cent	0	60-80
Operating conditions:		
Virgin charge, bbl. per minute	150,860	183,141
Recycle charge, bbl. per minute	34,395	29,752
Total charge, bbl. per minute	185,255	212,893
Recycle ratio, V/V	0.23	0.17
Reactor outlet temperature, °F.	864	849
Catalyst circulation, TPH	131	122
Yields—fresh feed basis:		
Conversion, volume per cent	50.2	51.7
Gasoline, volume per cent	39.1	40.4
Poly gasoline (C_4 only), volume per cent	2.2	2.2
C_4 cut (after poly), volume per cent	2.5	3.8
C_3 cut, volume per cent	2.0	2.0
C_2 and lighter (F.O.E. basis), volume per cent	6.0	4.7
Coke, lb. per hour	4,300	3,600
Gasoline octane rating, F-1 + 3 cc. TEL	95.4	95.8
Catalyst residual carbon, weight per cent	0.42	0.03

to take advantage of the high octane potential available with kaolin.

Commercial data . . . Numerous commercial cracking units which previously used bentonite clay catalysts are now using kaolin. Commercial data from the T.C.C. unit of Leonard Refineries, Inc. at Alma, Mich., are shown in Table 4. Kaolin catalyst addition was started in December 1955, with the catalyst added to replace normal unit losses. Thus, the kaolin concentration increased gradually with time.

Table 4 compares operating data from the period of September and October 1955, representing operation before kaolin addition with data from the period of September to November 1956 when the kaolin concentration ranged from 60-80 weight per cent. The effects of kaolin catalyst upon the Leonard operation are:

1. The increased unit activity of kaolin has permitted a 20 per cent increase in virgin charge to the unit and has increased conversion despite this higher charge rate. The higher conversion level was also attained in spite of reduced reactor temperatures and reduced catalyst to oil ratios, both of which give lower conversions.

2. The total gasoline yield increased more than 1 volume per cent. Coupled with the higher charge rates permissible with kaolin, the actual gasoline production increased approximately 25 per cent.

3. Yields of C_2 and lighter hydrocarbons have decreased substantially.

4. Kaolin operation has given a significantly reduced coke load in spite of increased unit throughput.

5. The gasoline octane rating increased even though the reactor outlet temperature was 15° F. lower.

6. The increased regenerability of kaolin together with the lower coke yield has almost eliminated the presence of troublesome residual carbon on the regenerated catalyst.

These commercial data on kaolin and bentonite differ from the pilot plant data in one very important respect. The cracking efficiency, or gasoline yield per unit conversion, is higher in commercial operation than predicted from pilot plant data. Pilot-plant data indicated that at constant temperature and conversion, bentonite produced more gasoline than kaolin.

The commercial data indicate that gasoline yield obtained with kaolin is the same as obtained with bentonite at constant temperature and conversion. In addition, this gasoline is of substantially higher octane rating. This same effect is confirmed in other commercial units where kaolin has replaced bentonite clay.

TABLE 5—TYPICAL COMPARISON OF KAOLIN WITH SYNTHETIC CATLYST PILOT-PLANT OPERATION

(Charge stock: gas oil from Arabian crude)

Operating conditions:	Kaolin	Synthetic
Temp., °F.	900	
Cat/oil ratio, V/V	5.0	
Space rate, V/H/V	3.4	1.6
Yields:		
Conversion, vol. per cent	50.0	50.0
Gaso., 385° F. at 90 per cent, vol. per cent	37.2	35.8
Total C_4 cut, vol. per cent	12.0	12.9
nC_4, vol. per cent	1.2	1.3
iC_4, vol. per cent	4.6	5.4
$C_4=$, vol. per cent	6.2	6.2
Dry gas, wt. per cent	6.1	6.1
Coke, wt. per cent	4.2	4.2
Gasoline octane ratings:		
F-1 clear	92.6	92.3
F-1 + 3 cc.	97.8	97.4

Commercial operation, then, indicates that when kaolin is used to replace bentonite clay the gasoline yield remains constant at constant temperature and conversion, octane rating of the gasoline increases, coke yield decreases, and unit activity increases.

Kaolin vs. Synthetic Catalysts

A typical pilot-plant comparison of the cracking characteristics of kaolin and synthetic catalysts when cracking an Arabian gas oil is presented in Table 5 at a constant conversion level. All operating conditions were the same for both catalysts with the exception of the space rate which was varied to give the desired conversion.

In general, these pilot plant data indicate that the cracking characteristics of kaolin and synthetic catalyst are similar in many respects. Both catalysts are sulfur resistant. Both catalysts give the same high gasoline octane ratings at comparable reactor temperatures. The yield structures exhibited by the two catalysts are also quite similar. Some salient differences of the catalysts are:

1. Kaolin exhibits a higher unit activity than the equilibrium synthetic catalyst. At otherwise constant reactor conditions kaolin gives the same conversion level at a higher space rate than synthetic.

2. Kaolin gives a higher gasoline yield than synthetic catalyst.

3. The isobutane yield obtained with kaolin is somewhat less than that of synthetic catalyst. However, the increased unit activity of kaolin permits higher conversion so that the actual production of isobutane on a barrels per day basis would be at least as great with kaolin.

4. Kaolin catalyst is substantially less expensive than synthetic catalyst.

Several commercial cracking units which previously had used synthetic catalyst are now using kaolin. Detailed data from these units cannot be disclosed at this time. However, the same discrepancies between pilot plant and commercial data previously described on kaolin and bentonite comparisons are also evident on kaolin and synthetic comparisons. Cracking efficiency obtained commercially with kaolin are higher, thus higher gasoline yields are obtained. The hardness characteristics of kaolin are such that attrition losses are the same or lower than obtained with synthetic catalyst. This, together with the lower cost per ton of kaolin, results in substantial savings in daily catalyst costs.

Acknowledgments

The authors express their appreciation to Leonard Refineries, Inc., for permission to use its operating data and particularly to J. S. Pfarr and C. E. Fiske for their cooperation.

BOOKS

PROLONGED ILLNESS - ABSENTEEISM. Published by the Research Council for Economic Security, 111 West Jackson Boulevard, Chicago 4. $10.

A 5-year study of nonoccupational illness by the Research Council for Economic Security shows that prolonged illness and absence from the job costs employes in private industry 13 per cent of their annual income. This is a total of $800 million in lost wages plus personal medical expenses. The study includes: Rate of absence, duration, and severity of prolonged illness; medical data on types of illness; functioning of company medical departments; efficiency of group insurance; medical care needed for workers studied; costs to individuals; costs to industry; cost to the nation; and rates of absenteeism by industries, age, sex, regions, and jobs.

ATOMIC APPLICATIONS WITH REFERENCE TO UNDERDEVELOPED COUNTRIES by Dr. Bruce C. Netschert and Sam H. Schurr. Published by Johns Hopkins Press, Homewood, Baltimore 18, Md. 129 pp. paper back. $2.

This publication is the result of a staff study undertaken at the request of the Ford Foundation. The purpose of the survey is to examine the various applications of atomic energy in its several forms; to summarize the present status, and to suggest the necessary conditions for the successful use of the several categories of application and indicate the current and planned activities in international cooperation for bringing the benefits of atomic energy to underdeveloped countries.

The survey is made in three parts: (1) the range of applications of nuclear energy, (2) the necessary conditions for using nuclear energy, and (3) international cooperation in nuclear energy research and development.

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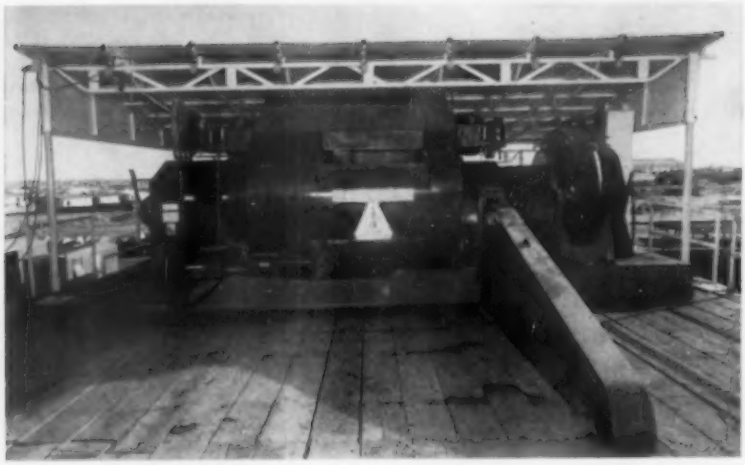
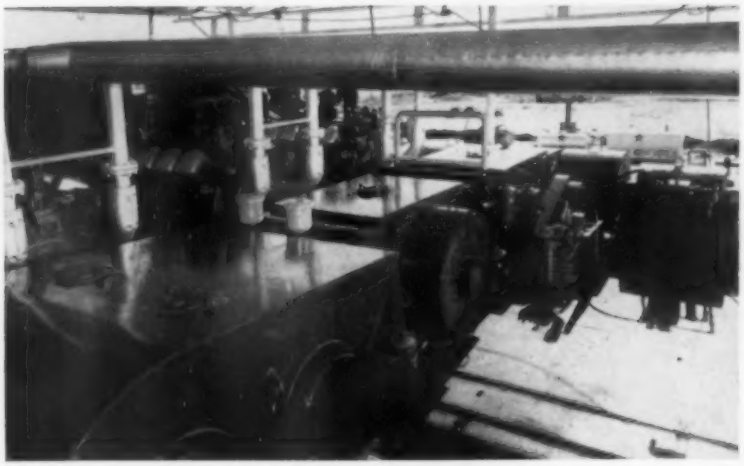


Four truckloads move big rig's draw works, its



1,800-hp. power plant, and chain compound. It's

Powerful and Portable

At moving time: break 17 unions, "unjay" 30 tie bolts, and you've got it made

By Ed McGhee
District Editor

A. W. THOMPSON'S new rig No. 1 is as powerful as any in West Texas today. Its three engines can put 1,800 hp. on the draw works or on the two mud pumps for drilling to depths of 20,000 ft. Yet, the rig is designed so that engines, draw works, and chain compound make only four truck loads. Pin-and-eye connections make rigup and teardown quicker. Moreover, the money-saving portability doesn't rob the rig of work space or convenience.

When a move is to be made by this rig, there are only 17 unions to break and about 30 tie bolts to "unjay." Most of the connections are pin-and-eye which are easily made or broken.

When the rig is set up on a new location, only one measurement must be made exactly—the distance from the derrick center line to the center line of the engine substructure. This is shown in rig layout. When this measurement is correct, all other dimensions take care of themselves as the equipment goes into place. A. W. Thompson men figure that they can tear the rig down, move it 50 miles, rig it up and begin drilling on a new hole in 3 to 4 days.

All this wouldn't be surprising on a light rig, but Thompson's rig No. 1 is as powerful as any operating in West Texas today. Its draw works will drill to 20,000 or 22,000 ft., using 4½ and 3½-in. drill pipe. The three drilling engines combine to produce 1,800 hp. that can be used either on the draw works or on the two mud pumps.

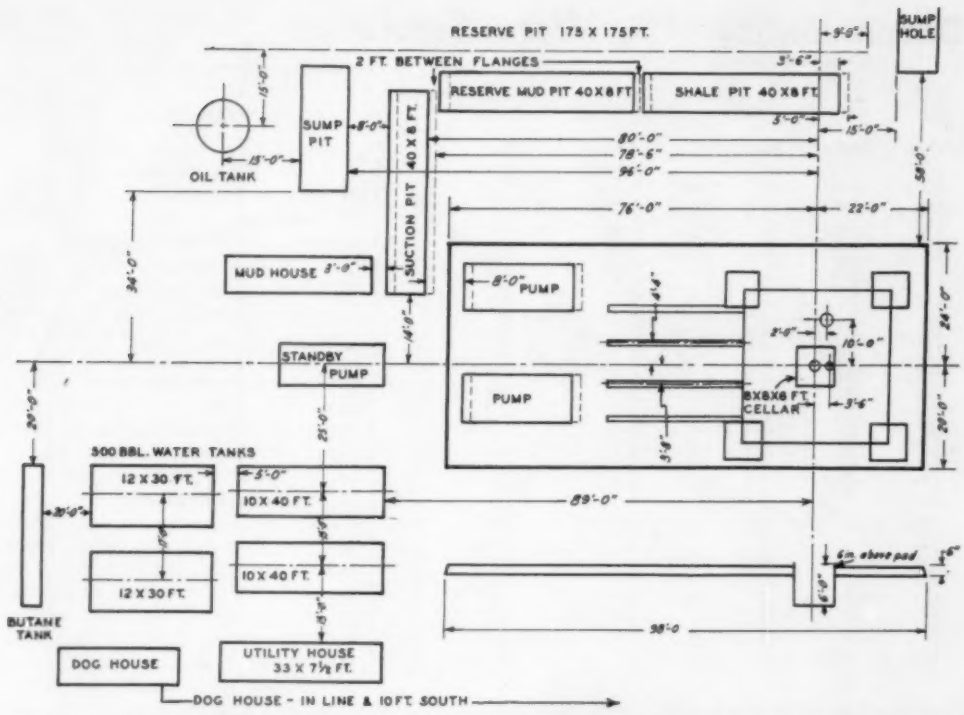
Few loads to move . . . One of the biggest reasons for the rig's portability is the design of the draw works and its drive. The draw works and its 60-in. hydromatic brake is a single truck load weighing about 78,000 lb. Each of the engines with its section of the chain compound is a single load; the individual weights are approximately: No. 1—38,000 lb., No. 2—33,000 lb., and No. 3—36,000 lb. Where it breaks between the engines, the compound case is designed to retain the oil and ease that moving problem.

The fewer loads to be moved, the cheaper it is to move. Besides, when rigging up or tearing down, the fewer packages to be handled on top of the substructure, the quicker and safer it can be done.

The draw works is rated for a pull of 467,000 lb. in low gear with 10 lines strung. In low gear with 12 lines, it is rated for 543,000 lb. Both figures include a safety factor of two.

Two substructure heights . . . The new rig will operate from either a 13 or 17-ft. substructure. To make the change from one to the other, it is necessary only to change the length of the belts driving the mud pumps. For the 17-ft. height, a base "pony" structure will be used, placing the regular substructure on top of that. For the 13-ft. height, only the regular substructure will be placed.

The purpose of the substructure heights is, of course, to allow enough underfloor space for all wells of 12,000 to 22,000 ft. total depth—the range in which this rig will probably drill. In areas such as parts of the Delaware basin, where there is danger



EXACT LAYOUT of equipment speeds rigging up. When the distance from the derrick center line to center line of the engine substructure is made, other equipment goes into place. Dashed lines are for 17-ft. substructure.

of gas collecting under the rig floor, the 17-ft. substructure will allow free air circulation to remove the gas.

Moreover, a full number of blowout preventers can be put on the wellhead without digging a cellar where gas might collect. On shallow wells or in areas where experience shows gas is no problem, the 13-ft. substructure will be enough.

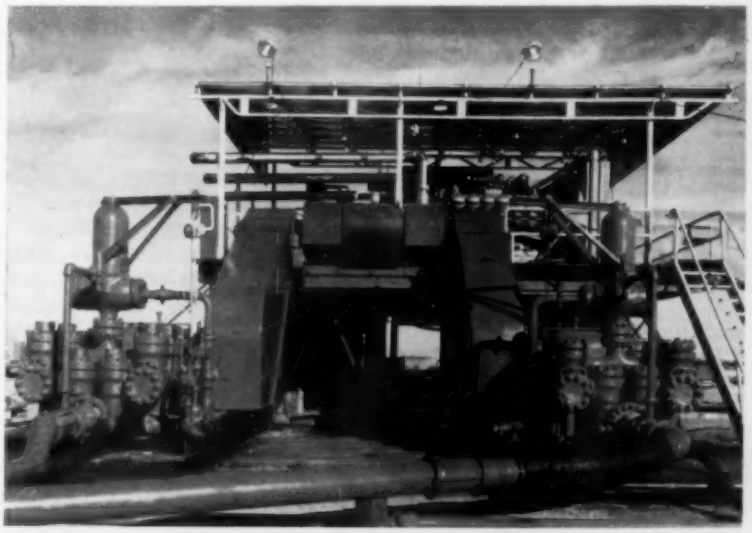
Normally, the rig will carry three or four 10,000-psi. test preventers. All will be pressure operated from an accumulator.

The rig has a standard derrick, 1,000,000-lb. nominal capacity which has a 30-ft. base and is 136 ft. high. The 27-in. rotary table is chain driven off the draw works.

Other loads . . . Besides the equipment already mentioned, there are two pumps with a belt drive from the rear end of the engine compound. Each of these is a truck load. Also, there is an independently driven standby pump, driven by a 300-hp. gas engine, that makes a load.

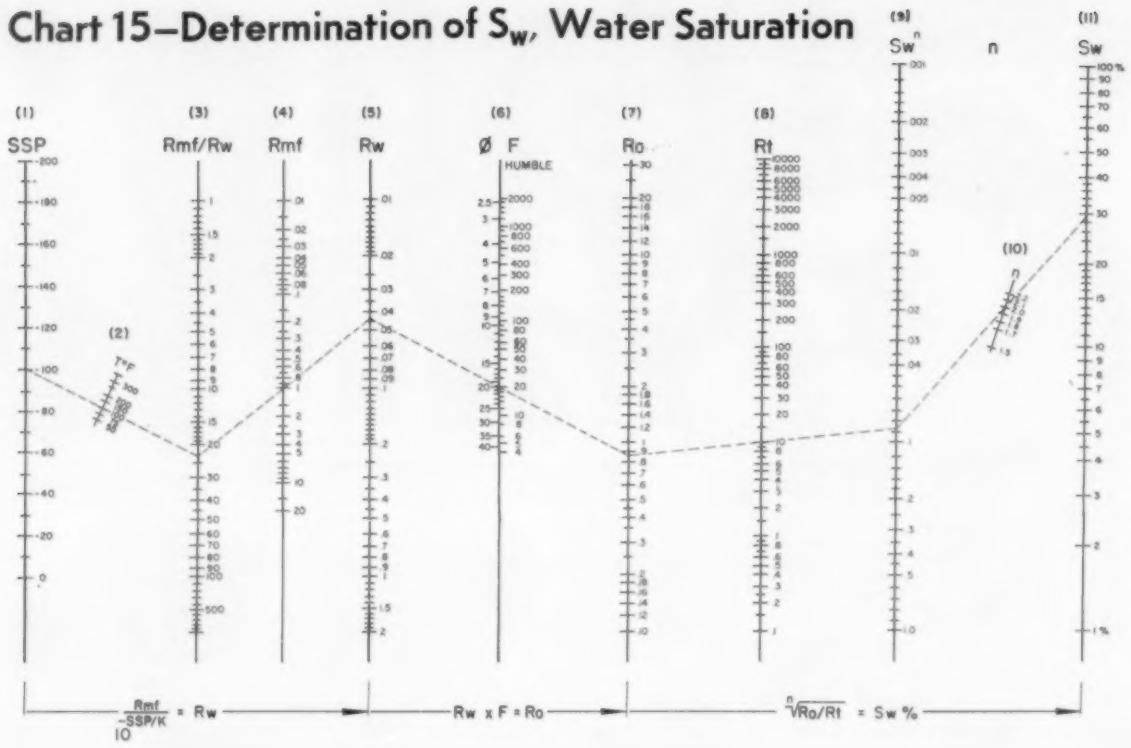
Additional equipment includes three 280-bbl. steel mud pits, three 500-bbl. water tanks, fuel tanks, weatherproof bunk house and dog house, and a steel mud house with sample house attached, all of which are skid-mounted so that each makes a truck load. A utility house which houses two water pumps, an additional air compressor, and a 15-kva. and a 10-kva. generator to power the rig's vaporproof lighting system is also included.

A hydraulically driven shale shaker is mounted on the mud pits while two air compressors with enough capacity to handle the rig requirements, including power slips if desirable, are mounted on sections of the compound. An air hoist has been mounted beside the V-door for safety and convenience of the drilling crews. **End.**



COMPOUND HOOKUP drives two main mud pumps. In addition, there is an independently driven standby pump. Main pumps each receive about 600 hp. and horsepower input of standby pump is 300.

Chart 15—Determination of S_w, Water Saturation



QUANTITATIVE LOG ANALYSIS—8

How to Determine and Interpret

WATER SATURATION

By Dr. R. G. Hamilton and Paul Charrin

CHART 15, consisting of 11 columns, is a summary of the steps in quantitative log analysis presented as a nomograph.

The first five columns are employed to determine R_w at formation temperature from the S.S.P. when R_{mf} is known. They solve the S.P. equation just as Chart 4. Chart 4 will give somewhat more accurate R_w values.

When R_w is known from water data, this value should be employed and the analyst then starts on column 5.

Columns 5, 6, and 7 solve the equation: $R_o = F \times R_w$. Φ and F will have been determined previously by one of the various methods.

Columns 8, 9, 10, and 11 solve the Archie equation: $S_w = (R_o/R_t)^{1/n}$.

Column 10 provides for a variable n from 1.5 to 2.2. If the n for the formation being analyzed has been determined from laboratory measurements, this value should be used to determine S_w. However, frequently this coefficient has not been measured or, if so, the information is not readily available to the analyst. n is usually close to 2.0 for clean, nonshaly formations. For moderately shaly sands n frequently varies from 1.7 to 1.9. For "dirty sands" containing abundant clay minerals or bentonite, n may vary from 1.5 to 1.7. Dirty sands are common in the bentonitic sands of the Tertiary and Cretaceous. The Wilcox and Simpson formations of Oklahoma and North Texas often contain illite and other clay minerals erratically distributed vertically and horizontally in the formations. The Deadwood formation of the Rocky Mountain area sometimes is highly contaminated with conductive clay minerals. The Aux Vases formation of the Illinois basin is characteristically dirty in many areas. The Tuscaloosa formation of the coastal areas is also frequently contaminated with conductive solids.

Dirty sands are usually easily recognized by the very low apparent resistivity values exhibited by all normal and lateral resistivity curves. When oil-bearing, the apparent values of all resistivity curves tend to be almost identical.

Column 6 relates Φ and F by the Humble formula. However, if the analyst has determined F by converting Φ to F by the Archie or similar formation-factor relationship, the F on the right side of Column 6 is still used for the calculation of R_o.

In using nomographic charts it is important to draw the lines across the

The authors are, respectively, head of Hamilton Well Log Consultants, Tulsa, and president of Perforating Guns Atlas Corp., Houston.

PRODUCING

columns with accuracy. Lines should be placed through the intersection of numerical values on the columns carefully.

Interpretation

Correct S_w and Φ data provide a basis for estimating stock-tank oil in place in a formation. The data are just as important to determine the advisability of testing or plugging wildcat and semiwildcat wells. Today the decision to test or not to test hinges frequently upon the data derived from the electric log.

Critical water saturations . . . Analysts have compared S_w data with initial fluid production for years and have established certain yardsticks sometimes called "critical water saturations" or "saturation indexes." The critical water saturation is usually meant to be the maximum per cent of formation water a bed can contain and yet produce water-free oil or gas.

For clean sandstones containing moderate to high-gravity oil, this value is usually close to 40 per cent.

For shaly sandstones the critical value may reach 45 to 50 per cent. For dirty sands or clay mineral contaminated sandstones the critical value is known to reach 60 per cent.

Critical values are not too well known for all limestones, partly due to the fact that the "apparent water saturation" derived from the analysis of conventional resistivity logs is probably not representative of the true water saturation in the porous and permeable sections that are often thin. However, much information indicates that oolitic limestones of high porosity may be treated as clean sandstones. Shaly limestones of moderate to high porosity sometimes contain 35 to 40 per cent water and yet produce clean oil.

Generally, low-porosity limestones of crystalline texture will produce water if the S_w value, obtained from conventional resistivity logs, exceeds 20 to 25 per cent.

Usually limestones of granular or "sandy" texture may contain more formation water than tight, dense, crystalline limestones, and produce clean oil.

Recently it has been found that some Mississippi lime sections in northern Oklahoma can contain as high as 70 per cent water and yet produce oil. These sections have the physical characteristics of siltstones although composed of calcareous materials. The calcareous Banff formation of Canada may also carry 65 to 70 per cent water and initially produce oil with little or no water.

"Critical water saturations" must be established for each formation through comparison of accurate S_w determinations with initial production. This involves an important experience factor in the correct interpretation of

TABLE 1—MINIMUM R_t REQUIRED FOR WATER-FREE OIL OR GAS PRODUCTION
(For nonshaly sandstones)

Formation temp., °F.—	100	125	150	175	200	250	300	
Porosity Φ	Formation water salinity 25,000 p.p.m. NaCl							
5	460.0	380.0	310.0	260.0	230.0	180.0	155.0	R_t
10	105.0	84.0	68.0	58.0	52.0	41.0	35.0	R_t
15	40.0	36.0	29.0	24.0	22.0	17.0	14.0	R_t
20	23.0	18.5	15.5	13.0	10.5	9.0	7.8	R_t
25	14.5	12.0	9.6	8.2	7.2	5.7	5.0	R_t
30	9.6	7.8	6.5	5.5	4.8	3.9	3.4	R_t
35	7.2	5.7	4.6	4.0	3.5	2.7	2.4	R_t
Φ	Formation water salinity 50,000 p.p.m. NaCl							
5	225.0	195.0	160.0	138.0	120.0	97.0	81.0	R_t
10	55.0	44.0	37.0	31.0	26.5	21.0	18.0	R_t
15	21.5	18.0	15.5	13.0	11.2	9.0	7.6	R_t
20	12.5	9.8	8.3	7.1	6.0	4.9	4.1	R_t
25	7.7	6.2	5.2	4.5	3.8	3.1	2.5	R_t
30	5.2	4.1	3.5	2.9	2.5	2.1	1.75	R_t
35	3.7	2.9	2.5	2.1	1.8	1.45	1.2	R_t
Φ	Formation water salinity 75,000 p.p.m. NaCl							
5	170.0	150.0	115.0	97.0	85.0	67.0	57.0	R_t
10	38.0	34.0	25.5	22.0	19.5	15.0	12.7	R_t
15	16.2	14.0	11.0	9.3	8.1	6.6	5.4	R_t
20	8.6	7.5	5.8	4.9	4.4	3.4	2.9	R_t
25	5.4	4.8	3.7	3.15	2.7	2.15	1.75	R_t
30	3.7	3.2	2.44	2.1	1.8	1.45	1.18	R_t
35	2.5	2.3	1.75	1.45	1.3	1.0	0.85	R_t
Φ	Formation water salinity 100,000 p.p.m. NaCl							
5	130.0	112.0	90.0	73.0	64.0	51.0	44.0	R_t
10	30.0	25.0	20.0	17.0	14.5	11.5	10.0	R_t
15	13.5	10.5	8.5	7.0	6.2	4.9	4.0	R_t
20	6.5	5.6	4.5	3.8	3.4	2.6	2.3	R_t
25	4.3	3.6	2.8	2.4	2.1	1.6	1.4	R_t
30	2.8	2.4	1.9	1.6	1.5	1.15	0.95	R_t
35	2.1	1.7	1.35	1.15	1.05	0.78	0.68	R_t
Φ	Formation water salinity 200,000 p.p.m. NaCl							
5	82.0	65.0	59.0	46.0	40.0	32.0	27.0	R_t
10	18.5	14.5	13.2	10.5	9.0	7.3	6.3	R_t
15	7.7	6.1	5.8	4.4	3.8	3.5	2.6	R_t
20	4.1	3.3	2.6	2.3	2.0	1.6	1.35	R_t
25	2.6	2.1	1.85	1.5	1.2	1.05	0.86	R_t
30	1.75	1.4	1.25	1.0	0.8	0.68	0.58	R_t
35	1.25	1.0	0.9	0.73	0.6	0.49	0.42	R_t

TABLE 2—STOCK-TANK OIL IN PLACE IN BARRELS PER ACRE-FOOT OF PAY

S_w per cent—	10			20			30			40			50		
Shrinkage factor	1.0	1.3	1.6	1.0	1.3	1.6	1.0	1.3	1.6	1.0	1.3	1.6	1.0	1.3	1.6
Porosity per cent:															
5	349	268	218	310	239	194	272	209	170	233	179	145	194	149	121
10	698	537	436	621	477	388	543	418	339	465	358	291	388	298	242
15	1,047	806	655	931	716	582	815	627	509	698	537	436	582	448	364
20	1,396	1,074	872	1,241	955	776	1,086	835	679	931	716	582	776	597	485
25	1,746	1,343	1,091	1,552	1,194	970	1,358	1,044	849	1,164	895	727	970	746	606
30	1,095	1,611	1,309	1,862	1,432	1,164	1,629	1,253	1,018	1,396	1,074	873	1,164	895	727
35	2,444	1,880	1,527	2,172	1,671	1,358	1,901	1,462	1,188	1,629	1,253	1,018	1,358	1,044	849

Range of recovery factors of per cent oil in place (Muskat, 1949; page 900):
For: Gas-drive fields . . . . . 15 to 50 per cent with 33 per cent median
Water-drive fields . . . . . 24 to 78 per cent with 52 per cent median

electric logs that cannot be overlooked.

Table 1 gives the minimum R_t required for water-free oil or gas production for many clean, nonshaly sandstones containing medium to high-gravity oil. The R_t values are for a critical water saturation of 40 per cent, for ranges of per cent porosity from 5 to 35 per cent, for formation-water salinities from 25,000 to 200,000 p.p.m. equivalent NaCl and for borehole temperatures from 100° to 300° F. This table may satisfy the desires of those who want quick rules-of-thumb, but it should not be applied indiscriminately to all formations and for all conditions.

To use the table: (1) determine borehole temperature opposite the clean sandstone as described previously; (2) determine formation water salinity from water data or the S.P. curve; (3) determine per cent porosity by one or more of the five methods; (4) read the R_t value corresponding to these data.

If the R_t determined for the clean sandstone is equal to or greater than the R_t value given in the table, the formation will usually produce clean oil or gas. If the R_t determined is somewhat less than the R_t given in the table, a cut of water is probable. If the R_t determined is greatly less than the R_t given in the table, the formation may produce principally water.

Comparison of electrically derived S_w values with core analyses . . . Total water from cores obtained in rotary wells drilled with conventional muds frequently ranges from 5 to 15 per cent higher than electrically derived S_w values in clean sandstones. The two tend to be in closer agreement in shaly formations. In dirty sands the two are frequently in complete agreement. One should bear in mind that electrically derived S_w determinations are independent of mud filtrate flushing when the logging device is definitely reading beyond the invaded zone.

S_w analyses from cores obtained in wells filled with oil are found to agree almost perfectly with the S_w derived from electric logs recorded in the wells after oil was replaced by conventional mud. Many comparisons and correlations have been made in South America, Canada, the United States, and Middle East.

Estimation of stock-tank oil in place. One may obtain an approximation of the stock-tank oil in place in a formation from the calculated S_w and Φ data from Table 2. For estimates of recovery the shrinkage and recovery factors must be known with some accuracy. For accurate appraisals the layman is advised to consult professional engineers and qualified appraisers.

Last of series . . . Preceding parts appeared as follows: Part 1, November 12, 1956; Part 2, December 3, 1956; Part 3, December 24, 1956; Part 4, February 18, 1957; Part 5, March 18, 1957; Part 6, May 6, 1957; Part 7, May 20, 1957.

ON THE JOB . . . . . IN THE FIELDS

Pipe Joint Used for Cuttings-Sample Dryer

THIS cuttings-sample dryer preheats its fuel to make it burn better. It is made from a short piece of 12-in. pipe with windows cut in the middle to make a place to put the samples. The samples are laid on the top of the lower half which is blanked off. The burner is underneath.

The top of the pipe is a tank containing the kerosine or crankcase oil or anything liquid that will burn. It is welded shut on the bottom with the top welded shut with provisions for filling through a 2-in. collar and bull plug. This plug is left loose to keep a vacuum from forming when the fuel is removed and also to prevent pressure buildup.

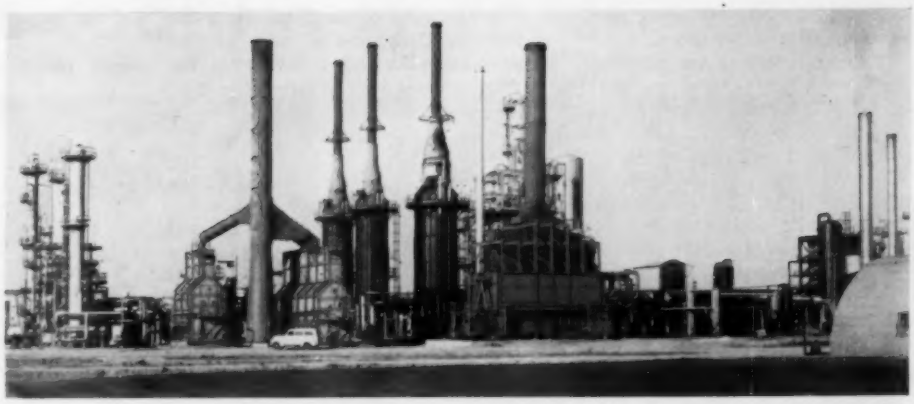
A copper tubing connects the tank to the fire chamber.

These Units Work in Tandem

TWIN pumping units are being used at two dually completed wells in the Belgian anticline area of San Joaquin Valley, California. In each of the dual setups, located less than 200 yd. apart, one unit pumps from a 3,290-ft. sand and the other from a 3,380-ft. pay. The installations, shown in the photo above, are on properties of A. J. West Oil Co.

The problem . .

A 50 per cent increase in plant's crude output



Existing units were revised to increase throughput from 20,000 to 30,000 bbl. per day of the Canadian Oil Companies, Ltd., refinery at Corruna, Ont.

Canadian Oil Companies, Ltd.'s refinery at Corunna, Ont., went into operation in 1952 with a design crude-oil throughput of 20,000 bbl. per day. This was an entirely new project complete with all supporting facilities such as docks, steam-generating plant, storage, shipping facilities, laboratories, water supply, and service buildings.

Crude oil from the Alberta fields of Canada is delivered by pipeline and lake tankers to the refinery docks. Process facilities include crude distillation and visbreaking, catalytic reforming, fluid catalytic cracking, gas recovery, and catalytic polymerization units.[1]

Within a short time the rapid growth of markets for the company's products prompted Canadian Oil's management to look for ways to effect a substantial increase in refinery capacity.

The target was a throughput of at least 30,000 bbl. of crude a day. An increase of this proportion required detailed examination of the feasibility of obtaining the capacity by alterations to the existing units, balanced against the other course of putting in new units to handle the additional throughput. Capital outlay, operating costs, loss of production during down time for making the changes, the maintenance of yield structure, and the speed with which the new capacity could be brought into use, were all considered.

By scheduling deliveries of the required materials and the mechanical operations for alterations and tieins, the required shutdown time was planned for an acceptable duration. The other factors were favorable to the program of increasing the capacity of the existing units, and this was adopted as the most favorable solution.

The solution . . .

Ripple Trays Did the Job

By T. J. Harvey and A. J. Connell

RIPPLE TRAYS provided the solution to several troublesome problems during the recent expansion at Canadian Oil Companies, Ltd., refinery at Corunna, Ont., near Sarnia. These versatile fractionation trays were installed in five columns. This allowed a 58 per cent increase in crude capacity at a cost of about one-third that of installing new capacity.

Other process changes were made, and steam-generating capacity was increased by installing a CO boiler at the catalytic cracking unit. Water-pumping and treating facilities were expanded. Small additions were made to storage capacity.

T. J. Harvey is chief engineer, Canadian Oil Companies, Ltd. A. J. Connell is with Stone & Webster Engineering Corp., Boston.

Crude unit . . . This unit consists of a pressure flash tower and a stabilizer for making light straightrun gasoline; an atmospheric tower for production of catalytic reformer feed naphtha, stove, diesel, and gas-oil cuts; a vacuum tower for production of gas oil as catalytic cracking unit feed; and a visbreaker for reducing the viscosity of the vacuum-tower bottoms.

The problems of expansion were the usual ones: to get the maximum duty from existing equipment, and to replace or parallel it only when no other solution could be found.

Piping considerations . . . A capacity increase of this magnitude necessitates compromises in the treatment of piping. Economic considerations of optimum balance between energy consumption and capital costs for pumping equipment on the one hand and capital costs for piping on the other dictate the original sizing. Redesign for increased throughput presents new economic criteria. Replacement of existing piping on a broad scale needs a long and costly shutdown. Furthermore, the spacing pro-

vided for the original piping may not accommodate larger lines.

Extensive studies are necessary to find ways and places to run new piping. With these complications and others, the over-all economics usually dictate retention of the existing piping, notwithstanding the additional energy and capital costs required for pumping. However, completely unacceptable pumping situations may still necessitate piping replacement. In the Canadian Oil refinery modification, such cases were few, although piping had to be added to tie in new pieces of equipment.

Exchangers . . . Heat addition to the crude and heat removal from the products necessitated a new furnace and additional tubular exchangers. Heat requirement for the original capacity was 113,000,000 B.t.u. per hour fired, supplied by four furnaces, one each on the primary tower, atmospheric tower, vacuum tower, and visbreaker tower. For the 50 per cent increase in load, an additional heater was installed, designed as a combination heater supplying heat for the atmospheric and vacuum service. The original arrangement of the plot area provided enough room for the heater installation without undue crowding of the unit area.

A total of 3,352 sq. ft. of tubular surface in three bundles and 2,135 sq. ft. of double-pipe extended-surface exchangers was added to effect heat removal from the products and to provide heat exchange to the crude. The heat-exchange scheme was modified to some extent, with the total surface for heat exchange to the crude becoming approximately 50 per cent greater than in the original design. No increase in condenser surface was required, as heat-transfer coefficients based on operating data indicated that the existing surface would limit throughput only in warm weather, if at all. It was, therefore, decided to defer any addition to condensers until operation at the higher rate showed whether it would be necessary.

The problem of increasing pumping capacity was handled by installation of new impellers where the duty was still within the capacity of the pump casing and driver. In other cases, existing pumps were replaced or paralleled by new pumps. Two new pumps and spares were added, one of them replacing an existing pump and the other operating in parallel with the originals. New instruments were added as required to control flow of the new pumps.

Increased capacity in distillation columns is the problem ordinarily least susceptible to satisfactory solution in a plant capacity-increase modification. Under the stimulus of war-production demands in the 1940's, distillation equipment of conventional design was tested to the limit of acceptable operation.[2] This was followed up by further research in industry, universities, and engineering firms. Designs were improved, loading factors were more firmly established and, in general, a higher rating for distillation equipment was established and used as normal design.

This resulted in more economical plants, but left little margin for additional throughput in bubble-cap columns. For the Canadian Oil expansion, operation at overloads which would impair fractionation could not be tolerated, as a primary concept of the capacity increase was that the product quality must be maintained.

Had a significant development in the distillation art not occurred in the very few years since the design of the original refinery, the engineers would have faced difficult and costly choices in seeking more capacity. Replacing towers by larger ones is often impractical, and paralleling existing towers is neither cheap nor entirely satisfactory, even when room is available to do so. New access structures, piping, instruments and pumps would have been required. Operating problems with two sets of towers would have been multiplied.

Ripple trays . . . Fortunately a new high-capacity fractionating tray, the Stone & Webster ripple tray,[3] had been developed and had reached the stage of commercial application.[4] Part of the commercial proving had in fact been accomplished by selective trial installations in this same unit. The engineers and management of Canadian Oil shared the confidence of the designers that these would answer the distillation capacity problem.

A total of 73 of these trays was installed in five columns, in sizes from 2 ft. 6 in. to 13 ft. 6 in., operating at pressures from 45 mm. Hg abs. to 200 psig., as shown in the following table:

Tower—	Section	Diameter (ft.-in.)	No. ripple trays	Tray spacing (in.)	Operating pressure
Primary	Rectifying	5-0	10	24	40 psig.
Atmospheric	Rectifying	9-6	25	30	Atmospheric
Vacuum	Rectifying	13-6	6	30	45 mm. Hg abs.
Stabilizer	.....	3-0	30	20	200 psig.
Visbreaker flash	.....	2-6	2	12	45 psig.

Modifications to the crude unit were made in only 30 days' shutdown time by careful scheduling of the necessary tiein and modifications. The unit reached a capacity of over 31,000 bbl. a day shortly after coming on stream, and was lined out at 31,600 bbl., 58 per cent over original design.

"A total of 73 ripple trays was installed in 5 columns, in sizes from 2 ft. 6 in. to 13 ft. 6 in. operating at pressures from 45 mm. Hg abs. to 200 psig."

The increase in capacity was obtained at a cost of approximately $60 per bbl., about one-third of the cost of this capacity in a new unit.

In addition to the capital cost savings, a very substantial advantage is gained in operating costs, compared to those which would be encountered if the additional capacity were in a separate unit.

Improved fractionation . . . Even at the new high capacity, improved fractionation was seen on some of the products. With a 235° F. initial boiling point on the naphtha, the light straightrun gasoline 90 per cent point decreased from the 240° F. obtained with the old trays to 218° F. This resulted in an improvement of four octane numbers on the light gasoline, and two octane numbers on the naphtha after reforming, presumably because of inclusion in the naphtha under the new fractionating conditions of certain compounds, which reform easily, boiling in the area of the gasoline-naphtha cut point.

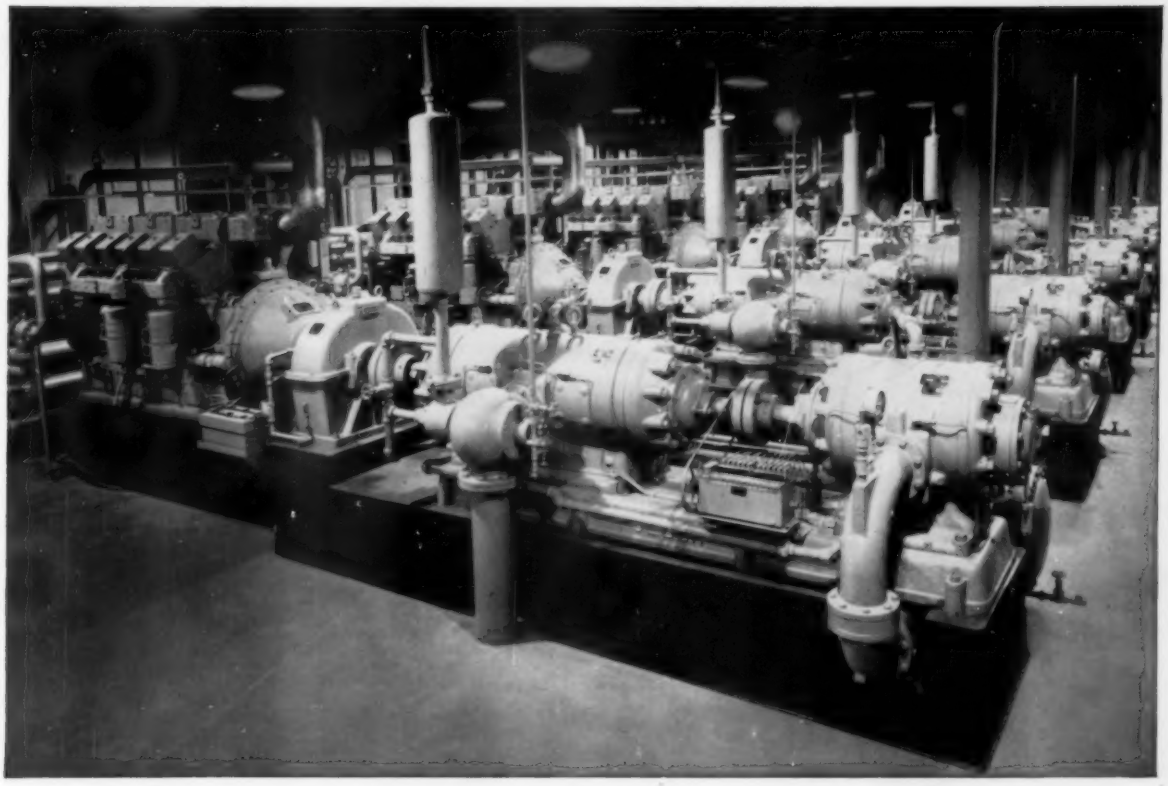
In service on the visbreaker flash tower, the new trays exhibit a self-cleaning characteristic which keeps them free of coke. The carbon-steel bubble plates previously used accumulated coke, requiring periodic clean-outs.

On the vacuum tower, a yield of 12 per cent bottoms is being obtained on Redwater (Alberta) crude. The vacuum tower operates with approximately the same pressure drop, vaporizer top to top, at 31,600 bbl. equivalent crude rate, as with the old trays at 20,000 bbl. crude.

References

1. Smith and Maslyk, World Petroleum, May 1952.
2. Petroleum Industry War Council, T.A.C. Reports, 1944-1945.
3. U. S. Patent 2767967.
4. Hutchinson and Baddour, Chemical Engineering Progress, Vol. 52, 13, December 1956.

LUBE OIL COOLING BY ROSS



Five Climax Engines stir up a gas hurricane

Five Climax Model V-120 natural gas engines supply the power to stir up a veritable hurricane of gas in this propane-air plant at Alameda, New Mexico. They drive rotary compressors which move almost 9 million cubic feet per day!

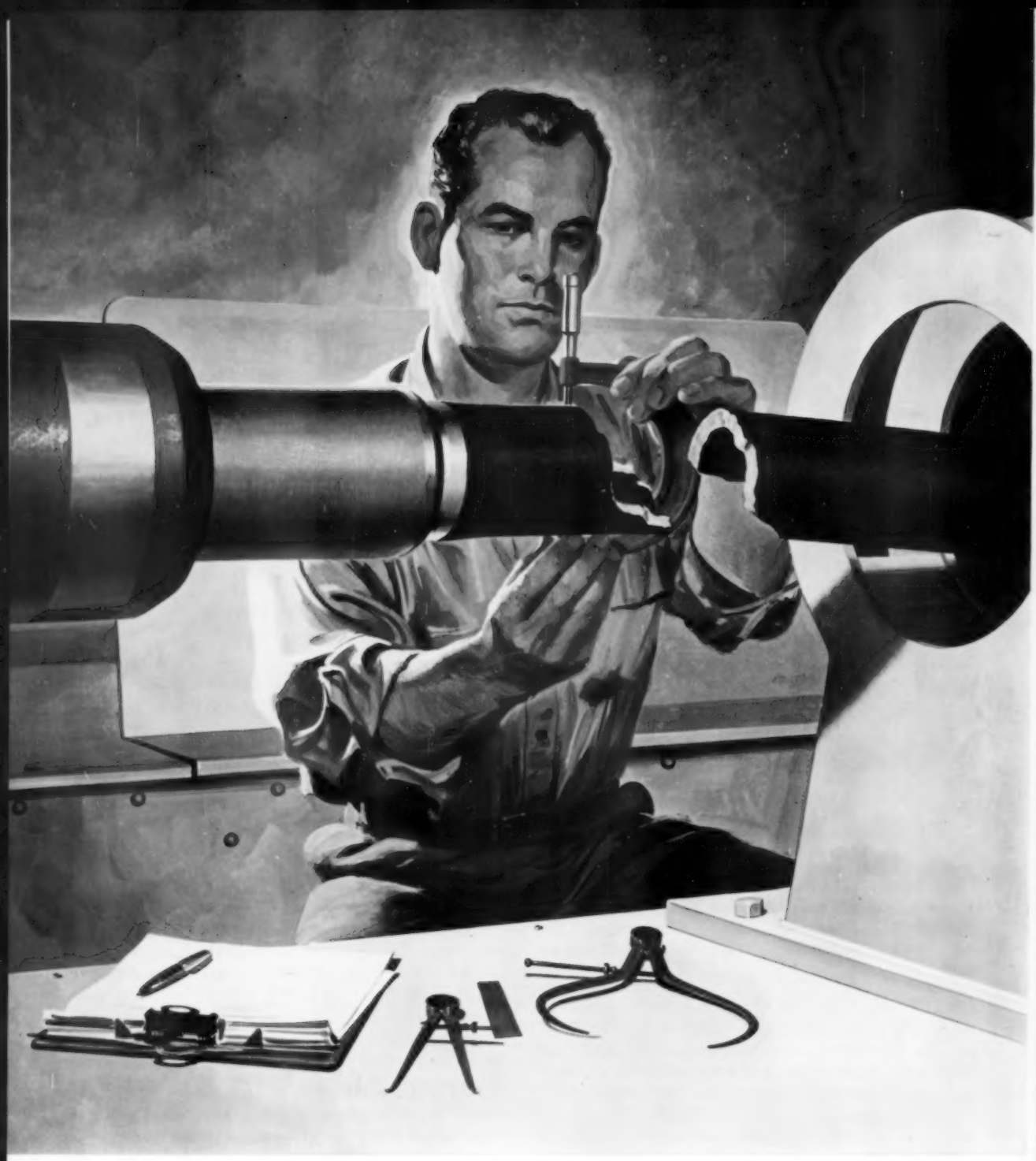
ON THE JOB to maintain continuous, trouble-free lubrication are Ross Exchangers. Installed by Climax as original components, they supply properly cooled oil to crankshaft, piston pin, governor and camshaft bearings...all vital parts. Long trouble-free service is assured.

IN PETROLEUM REFINERIES and pipeline compressor stations throughout the world, you'll find Ross Exchangers serving engines, compressors and practically every type of prime equipment that requires temperature control of lube oil, jacket water, hydraulic fluid and fuel oil. Combining high thermal efficiency and extreme ruggedness, they're pre-engineered, fully standardized and available in a wide range of sizes to meet your needs.

IF YOU HAVE A HAND in any equipment where heat transfer is a factor, it will pay you to learn more about Ross Exchangers. Detailed information can be obtained by requesting Bulletins 1.1K5 and 2.1K5. Write: Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

ROSS HEAT EXCHANGER

Division of AMERICAN-Standard



Hughes Engineering and Research Developments

1919 First heat-treated alloy steel tool joint — to make the use of tool joints economically feasible.

1929 First bucked-on tool joint with controlled torque — to minimize washouts.

1933 First bucked-on and welded joint — to prevent last engaged thread failures.

1937 First bucked-on and counterbore welded tool joint — to reduce welding cost for the operator.

1938 Introduction of *first unitized drill stem* — after three years of full-scale research into flash-welding process.

1942 Introduction of hardfacing in depth on "Flash-Weld" tool joints — to lengthen the life of joints.

1942 Refinement of flash-welding techniques — to permit use of smaller pipe upsets.

1945 Introduction of copperplat-

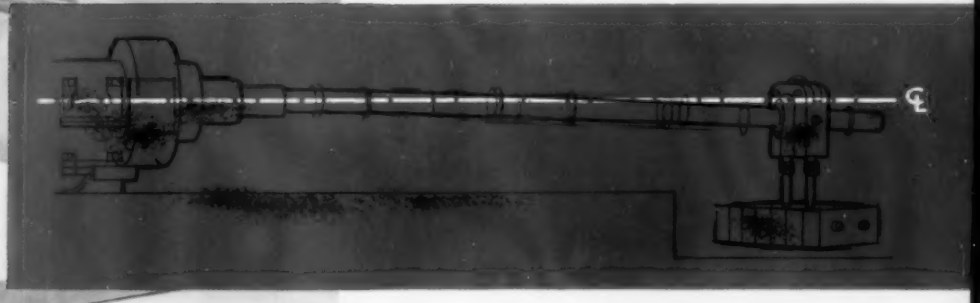
out of CONTROLLED DESTRUCTION comes progress

Three specially designed rotating fatigue machines are kept in operation 'round the year testing drill stem to destruction.

Pioneered by Hughes as early as 1931, the use of fatigue machines has contributed importantly to the advancements made to date.

These machines are now being used in one of the most extensive programs yet undertaken. The purpose: to provide improved tool joint-to-pipe connections to meet the higher stresses of deeper drilling anticipated in the years ahead.

Always out in front, HUGHES' continuing research assures the operator that his drill string — for the *present* and the *future* — will have the most dependable tool joint-to-pipe connections that he can run in the hole.



ing of box and pins — to minimize galling.

1947 Stress-relieving of weld zones in high alloy and all other grades of pipe.

1956 Development of techniques and equipment for cold-rolling large land area of pipe — to strengthen pipe and "Seal-Grip" tool joint assembly.

1957-'67-'77. . . Continuation of the search for the new and better tools for tomorrow's needs.

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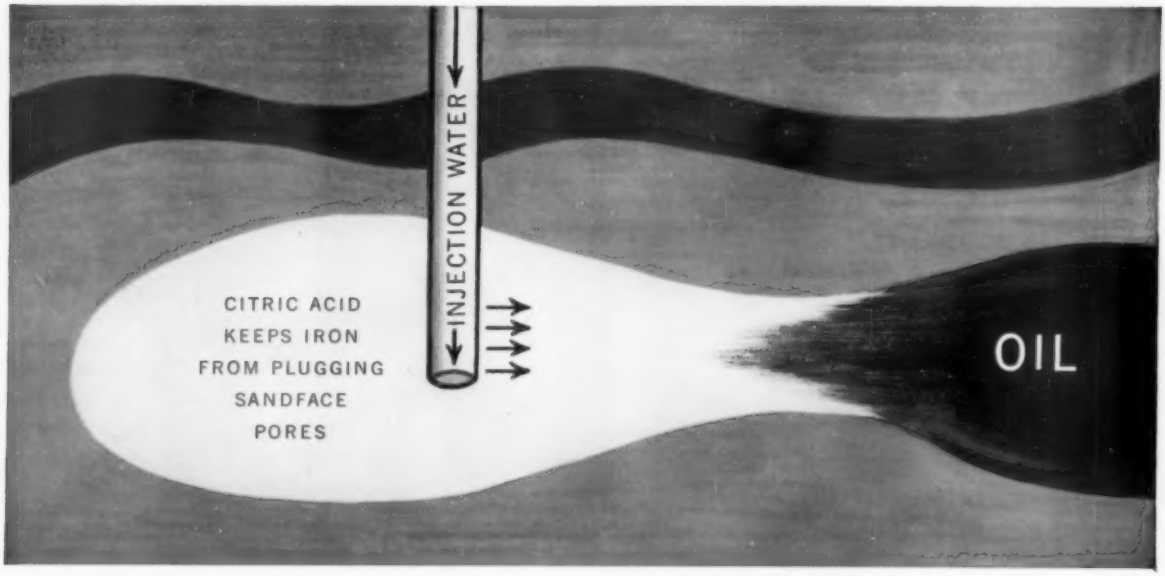
Improve flow rates in secondary recovery



Add CITRIC ACID to injection water

● When you add citric acid to injection water you prevent the formation of iron precipitates which plug the sandface, restricting the flow rate. This means that you reduce the need for temporary (and sometimes costly) methods of freeing iron-plugged wells.

Also important, citric works even in high calcium waters. Citric preferentially sequesters the iron and keeps it soluble. Other ions do not interfere.

Pound for pound, citric acid sequesters iron better and at less cost than any other agent. It's nontoxic and safe to handle, too.

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CITRIC ACID ADDED
In this bottle, only 10 ppm of Pfizer Citric Acid has been added to brine containing 2 ppm iron.

NO CITRIC ADDED
The brine in this bottle also contains 2 ppm iron. But no citric has been added.

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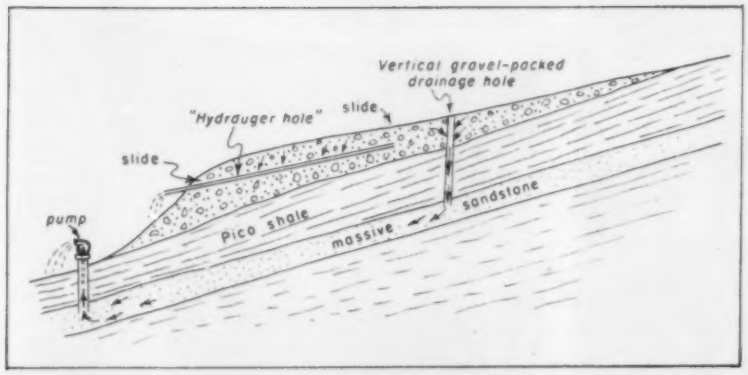
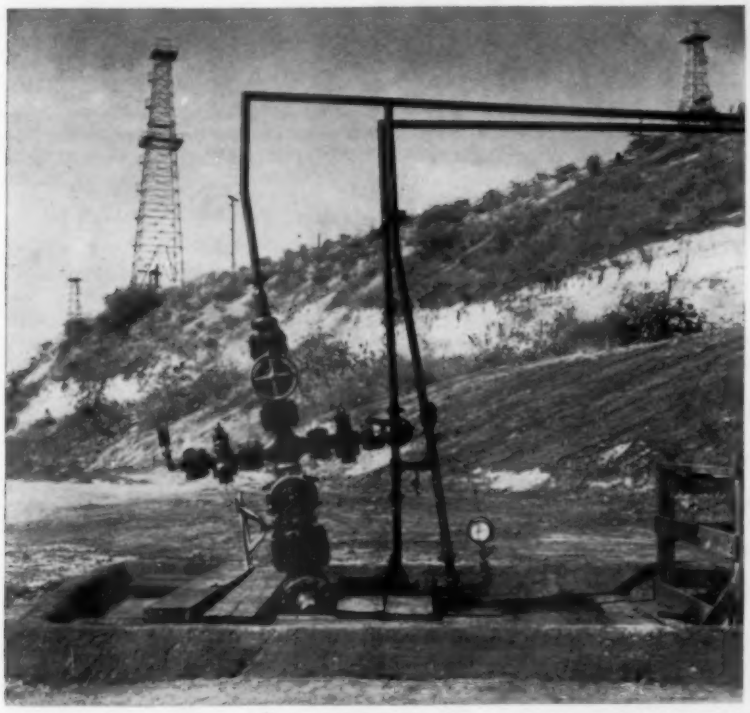


HORIZONTAL DRAIN HOLES drilled into the slipping overburden, and vertical holes which drain subsurface water into an underlying sandstone help prevent . . .



. . . EARTH SLIPPAGE, such as that which caused this canted christmas tree. This well was saved by constructing a cribbed shaft to a depth which penetrates the slide plain. These are some of the measures Ventura operators use to . . .

Stop Costly Landslides

By D. H. Stormont
District Editor

IN ADDITION to routine problems connected with oil-field operations, operators in Ventura Avenue field, coastal California, are faced with landslides which have damaged a large number of oil wells.

Old topographic maps show that some of the slides were in existence long before oil was discovered at Ventura. As long ago as 1926 earth slippage damaged some wells. In 1941 a major movement damaged 23 wells. Movement of almost 500,000 cu. yd. of earth was required to stabilize the slide.

To date the costs of damage repair and corrective actions taken to reduce slippage have exceeded $3,000,000. Some grading and earth removal is occasionally required to stabilize slide areas. But a preventive-maintenance program being followed is keeping movement to a minimum and prolonging the intervals between major slips.

. . . **Preventive measures** consist of draining subsurface water through "hydrauger" holes, control of surface drainage by gunite-lined waterways and contour levees, and the extraction of underground water through wells and shaft pumps. To minimize the percolation of water into the soil, vegetation is stripped from the sliding ground and the surface oiled.

Purpose of the hydrauger holes is to intercept subsurface water before it reaches the slide plane (see diagram). Removal of the water reduces lubrication along the plane, the main cause of slippage of the earthen overburden. Holes totaling more than 40 miles in length have been drilled into the slides, which vary in thickness from 20 to about 200 ft.

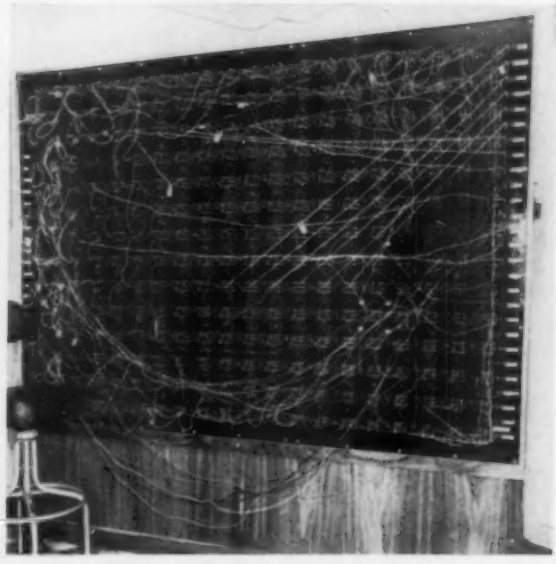
In the eastern part of the field Tidewater Oil Co. has nine slide areas on its large leases. A total of 1,103 hydrauger holes have been drilled in these areas. In wet seasons these holes yield a maximum of 300 bbl. of water daily. In summer months the volume drops to about 120 bbl. daily.

To further drain the sliding areas Tidewater uses vertical gravel-packed holes. As shown in the diagram these penetrate the sliding beds in the upper portion of the sliding area, and are bottomed in a massive sandstone below the slide plane. Water thus is drained from the overburden through these holes and is produced through wells drilled near the base of the slide.

. . . **Slide damaged wells** usually are restored to production by providing a cribbed shaft around the casing to a depth which penetrates the slide beds. Some cellars have been dug to depths of over 100 ft.—at a cost of about $100 per foot.

Largest of the slides covers 160 acres and has been measured to be some 20 to 150 ft. thick from the surface to the bedding plane. It was this slide which damaged the 23 wells in 1941 — distorting the casing so badly that production was cut off. Since 1952 there has been very little movement in this slide, indicating that the preventive measures have been successful. **End.**

CONTROLS on oil-pool analyzer permit simulation of pressures, and well production and injection rates. Any desired producing conditions can be set and tested. Fig. 1.



MATRIX NETWORK of oil-pool analyzer represents electrically the actual reservoir. Resistors between matrix points control flow of current just as permeability does in reservoir. Fig. 2.

Electronic Computers' Magic Talents Speed Improved Production Technology

Among other problems they're solving are . . .

- How to predict the influx of water into a reservoir.
- How much oil will be displaced by water or gas.
- How to predict oil-gas phase behavior.
- How to analyze seismic reflection-time data.
- How to improve the odds of oil finding.

By Dr. W. A. Bruce
Carter Oil Co., Tulsa

RECENT developments in analog and electronic digital computers are becoming highly valuable to reservoir analysis. These computers make it possible to overcome some computational difficulties that have been holding back important technical developments in the production of petroleum.

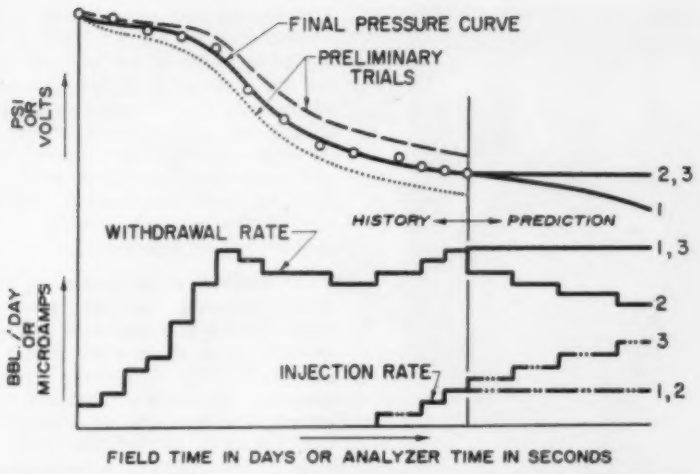
Mathematical techniques have been prominent in the development of an oil-production technology. But while the process of producing oil from subterranean reservoirs can be described in terms of differential equations, the boundary conditions in all practical cases are very complex, and in systems involving more than two fluid phases, nonlinear terms usually appear.

To solve problems by ordinary mathematical methods, undesirable simplifying assumptions about boundary conditions necessarily have had to be made and unrealistic representations have been employed. Even so, a lot of good exploratory work has been done with the slide rule and desk calculator. High-speed computers are now making it possible to use more realistic boundary conditions in calculations and are obtaining solutions that could not even be attempted without them.

Favorable attitude . . . Management people in the petroleum-production industry have shown a keen interest in using mathematical methods to analyze and predict petroleum performance. They early recognized that a reservoir could not be rerun like a refinery to determine optimum production conditions. This interest is expressed in the widespread use of expensive analog computers by the industry and the recent acquisition of digital computers for scientific work by almost every major oil company.

Those of us who are concerned

PRODUCING



SOLUTION of a reservoir problem by analog computer involves preliminary trials to match reservoir history then computer operation to predict future conditions. Fig. 3.

with getting the mathematical work done are most pleased with the rapid improvement in the adaptability of digital computers.

Oil Production by Water Drive

The energy for displacing the oil into the wells from a large number of oil pools is derived from water lying in the surrounding aquifer. The foremost problem here is to predict how much of this water will be available, and what processes can be employed to enhance the natural water drive.

Although over 20 years ago this problem appeared to be solvable mathematically, only during the last decade have really practical and universal techniques been worked out to predict the influx of water into an oil reservoir.

The method now most widely used employs an electric analyzer which has, for purposes of communications and ready use, been made into a direct-analogy computer. This analogy is carried out first through the direct relationship between the flow of oil or water through a porous rock and the flow of current through a resistor. The second analogy is between the fluid storage capacity of a rock and the electrical storage capacity of a condenser. Further refinements and special nonlinear problems are taken care of with an electronic device in which the storage capacities can be altered by a functional variable.

Lab apparatus . . . Fig. 1 shows the main unit of an electric-analyzer installation. This apparatus contains the special circuits and equipment necessary for controlling the various parameters, testing the operations, and recording data.

The analog network unit is shown in Fig. 2. This network contains 526 resistors, which are variable over a range from 0 to 20 megohms. External resistors may be added to increase this range to infinity. The unit has 280 control points, each of which may be connected to a condenser of from 0.1 μf. to 3,000 μf.

Setting up a problem . . . The first step in solving a large-scale problem with the analog computer is to fit into the electrical system, as accurately as possible, the constants concerning the nature of the aquifer, the location of pools, the location of faults, and other known information. The computer is then adjusted to represent varying boundary conditions that are in keeping with the observed behavior of the pool or pools under consideration.

Preliminary results of such an operation are usually obtained by a trial-and-error method, as shown in Fig. 3. The reasonable and probable variations in geological conditions are assumed and used until the resulting electrically produced history fits the actual observed history. The machine is then ready to predict what would happen to the pressure under a variety of future producing conditions, or what would happen to the production under a variety of imposed pressure restraints.

Digital computing . . . Perhaps one of the most important recent developments in water-drive analysis has been the use of the analog computer in combination with the digital computer. (Fig. 4). Use of the digital computer speeds up the work and puts the answers in the most usable form. Various techniques have evolved, but probably the most important method is one in which the electric analyzer derives a set of functions based on the geology and past history, and then, based on these functions, the digital computer calculates performance for any arbitrary future operating schedule.

One might raise the question here as to why the entire job couldn't best be done by digital computer, and in time it is entirely possible that such a transition will be made. However, after considerable work with both types of computers, we have come to the conclusion that the analog device is, under almost all conditions, more adaptable to the inference of aquifer and geological conditions based on observed production and pressure behavior, and hence is the best for this phase of the operation.

Studying water advance . . . For practical application, it is essential to determine quantitatively how much oil can be produced under the influence of water influx into a pool. In other words, for predictions of oil production rates and total oil reserves, we have to incorporate into our studies core-analysis results, which tell us how much oil will be displaced when water flows into the reservoir rock. The number of calculations involved in such an analysis is unusually large, so a method has been worked out to use the magnetic-drum computer.

A recent problem illustrates this technique. After obtaining displacement efficiencies by detailed core-analysis studies, we determined how much water would go into the total reservoir and how much would go into each of the different reservoir layers. This was done with the electric analyzer and network unit. The reservoir was divided into zones and the displacement of oil from each zone was calculated on the basis of core analysis.

We also predicted when the water would arrive at the different wells, where new oil wells should be located, where injection wells should be drilled, and how much water should be injected into each injection well. When all these calculations were completed, we were able to predict the best operating conditions to obtain maximum oil recoveries with minimum costs in this field.

The calculations required for this analysis, using the digital computer, took only about 15 hours total machine time. If this had been done by desk calculators, it would have taken one man about 20 years, working 40 hours a week.

Displacement of Oil by Other Fluids

The problem of displacement of oil by other fluids is not easy to solve

MAGNETIC-DRUM digital computer used at Carter laboratories speeds many production problems. One use is analyzing water drives in combination with analog computer. The author, Dr. Bruce, is at right. Fig. 4.

by the use of analog machines. For example, as oil is displaced by gas, a two-phase region is developed; that is, the gas-invaded region contains both oil and gas. In this region, the oil saturation varies, since the displacement is not pistonlike, and the transmissibility of each phase varies nonlinearly with saturation.

If capillary pressure effects are neglected, there is a bank, or discontinuity, in saturation at the front of the displacing phase. If capillary pressure effects are not neglected, the bank is replaced by a region in which saturation varies rapidly.

The bank region is then almost analogous to a shock wave. There is no simple analogy to this in an electric-circuit design, and in a mechanical analog computer, instability conditions probably would develop. Approximate solutions can be determined mathematically, but they have undesirable limitations.

... **The basic equation** describing the displacement of oil from porous rock was first proposed by Buckley and Leverett,[1] who realized at the time of their discovery that there is a shocklike character to the displacement of oil by water, and who also deduced the basis upon which the propagation of this shock can be computed.

In the Buckley-Leverett analysis, the reservoir model used is essentially a prism, within which homogeneity of the porous medium is assumed. The displacing fluid is injected at one end of the prism, and reservoir production is represented by efflux at the other end. If the displacing fluid is water, no mobile gas phase is present in the model. If the displacing fluid is gas, no mobile water is present in the model, and pressure must be maintained within a range in which fluid properties may be assumed constant.

If the model is essentially horizontal, the injection rate can be varied, since the distribution of saturation within the invaded region is determined only by cumulative injection. If the model is tilted so that gravitational segregation of the phases is important, the injection rate must be held constant.

In order to obtain more realistic predictions of the production history of a reservoir, we have made some modifications of the Buckley-Leverett approach and have developed several different mathematical analyses.

... **An obvious improvement** is a model divided into noncommunicating strata of different properties, each uniform and homogeneous within itself. In the case of a horizontal model, the saturation at the bank, or discontinuity, is constant in each stratum, but its value depends on the formation and fluid properties within the stratum.

Although the pressure drop between ends of the cylinder is common to the strata, the portion of total injection going into each stratum varies continuously, and breakthrough of the displacing phase at the outflow face for one stratum is followed almost immediately by a strong bypassing effect—that is, a greater efflux of the displacing fluid from one stratum and a reduction of oil-production rate from all strata. An example calculation of this required 2 weeks on a card-programed calculator.

... **Another modification** of the Buckley-Leverett analysis gives a method in which a multizone approximation in a single-layer model is represented. Fig. 5 shows a vertical section of a reservoir, and the new model, which consists of homogeneous cylinders. Withdrawal from a zone of the reservoir is represented by withdrawal at a boundary of the corresponding zone of the model; the remainder of the efflux flows on into the next zone.

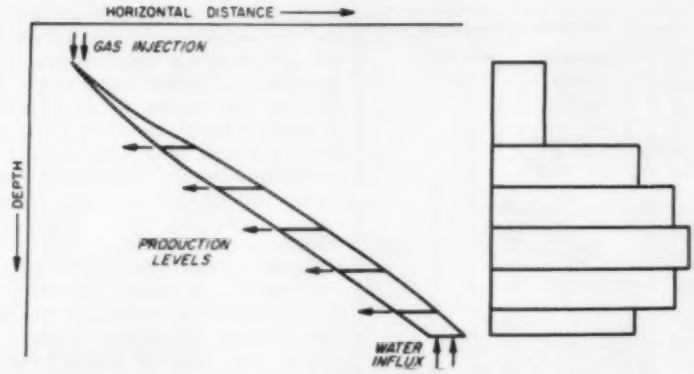
In this model, saturations are usually continuous within the invaded region inside any zone, but may be changing continuously at a bank. Secondary banks may be developed within zones by reducing the throughput rate.

Gas may be injected at the top of the field, water may be injected at the bottom, and either may be injected at a common boundary of two zones. Consideration of these conditions required that the analysis be extended to include counterflow of phases.

... **The first satisfactory application** of this analysis[2] was the calculation of 12 years' history of Mile Six pool in Peru, where there was no appreciable water influx. It was here that we made our first use of a high-speed computer.

Numerous difficulties were met. Unexpected bulges in both the saturation and pressure curves developed. As a result of these difficulties, several changes were made in calculation techniques. We became more careful in our use of P.V.T. data, since we found that experimental errors could lead to incompatible formulas for interdependent fluid properties. Eventually a satisfactory model of the reservoir process was evolved, and the calculation was made routine.

... **A related problem** is that of the so-called "natural depletion" process. Most petroleum contains dissolved gas. As the reservoir pressure is reduced, this gas comes out of solution and provides an internal drive that can push a fraction of the oil into the producing wells. Usually this producing mechanism is inefficient; hence one of the fluid-injection proc-



VERTICAL SECTION of a reservoir, left, is represented by model at right for computer analysis. Production at any level is represented by a withdrawal at a zone boundary of the model. Fig. 5.

esses is eventually used and the declining pressure, needed for the natural depletion process, is stopped.

In many reservoir studies the history includes a natural depletion period during which the pressure declines, water invades the pool from the aquifer, and gas comes out of solution in the crude oil.

How much time needed? . . . In a typical solution-gas-drive problem involving declining pressure, the magnetic-drum-computer calculation of one time step can be completed in about 2.5 hours. A card-programed calculator requires 20 hours and desk machines 40 hours for the same calculation.

The magnetic-drum computer has an additional advantage in that there is no possibility of inadvertent adjustment of formulas or numbers by the engineer to compensate for error in fundamental theory. Calculations would break down approximately 2.5 hours after the error became effective. Card-programed calculations might continue for as much as 2 weeks and desk-machine calculations as much as 4 months before the error became obvious.

Trouble-shooting is relatively simple with the magnetic-drum computer; after selective monitoring of a few calculations, the analyst can quickly determine the source of trouble while still familiar with the details of the analysis. Detection of errors in the slower machine calculations involves examination of a great many numbers and a detailed review of the analysis.

Miscellaneous Problems

Velocity profiling . . . Geophysical applications of magnetic-drum computers have been chiefly concerned with the seismic reflection method, specifically with a technique called velocity profiling. This technique is an attempt to analyze reflection-time data recorded at various points on the surface of the earth so as to obtain the geometrical configuration and the seismic velocity of the layers in the earth.

Most of the computations have been of the arrival times of reflected waves. A ray is started out at a selected angle with the vertical, and mathematically traced down through the various layers and back up to the surface, where its point of emergence is noted. The intial angle is then adjusted and the computation is repeated until the ray emerges at the desired point.

Programing the computations has been made much easier by the use of a floating decimal subroutine for the digital computer and a simulated index register, which is used to modify data addresses. In these layered-model problems, after the computation of a ray through a layer is complete, the index register is altered so as to replace the parameters of that layer with the parameters of the next one, and the program is repeated. The computation of reflection time for a typical model with 3 layers, 13 geophones, and 2 shot points takes about an hour. Graphical methods would take weeks.

Gravity interpretations . . . An entirely different field of geophysics to which the modern magnetic-drum computer has recently been applied is that of gravimetric exploration. In this method the acceleration due to gravity is measured, and a correction for elevation is applied to each measurement. The regional trends are then determined, and the residual gravity at each station is computed.

The chief computation to be performed is the fitting of high order (perhaps sixth) polynominals in two variables to a large number of points (perhaps 5,000), and the computation of the residual values at each station. In some cases it is sufficient to fit only the values at a rectangular net of grid points, in which case tables of orthogonal polynominals in x and y can be used. In our laboratory these tables of orthogonal polynomials have been put on cards, and a machine subroutine for matix multiplication has been prepared.

K-Values . . . In reservoir-engineering work, oil-gas phase-behavior calculations on specific problems are often necessary. The results of these studies depend to a large degree upon the equilibrium vaporization ratios (K-values) used. These ratios are known to vary not only with pressure and temperature, but also with composition.

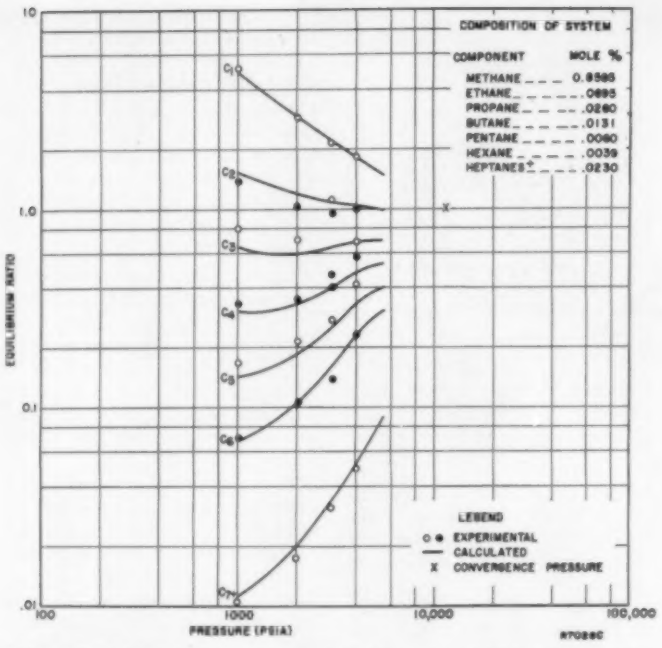
At present, the only commonly accepted method for determining K-values involves time-consuming and expensive laboratory analyses of each fluid being studied. Moreover, such analyses are subject to large errors even when careful laboratory techniques are employed. Research work is in progress to develop a dependable method of calculating equilibrum ratios which does not involve elaborate laboratory procedures.

The calculative procedure that has been developed requires a small amount of experimental data, but it eliminates the necessity for experimentally determining phase compositions to establish K-values. Using the digital computer, a set of equilibrium ratios can now be obtained for a reservoir fluid in less than 2 weeks' time. Most of this time is spent in determining and processing the small amount of basic data required; the actual calculation time amounts to only a few hours.

Fig. 6 shows a set of calculated K-value curves compared with actual measurements.

Material balance . . . Many of the routine calculations performed by the reservoir engineer are readily adaptable to the electronic digital computer. For example, the material-balance equation, one of the most valuable tools of the operating engineer, is easily programed and quickly solved with the computer. With this equation it is possible to estimate oil reserves, determine and evaluate the types of producing mechanisms that are active, determine the net changes in volume of the oil and gas zones, calculate the amount of water influx, and predict the future behavior of the reservoir.

The Muskat-type material-balance analysis, Buckley-Leverett analysis, single-well analysis, and other reservoir-engineering calculations requir-



EQUILIBRIUM RATIOS for a reservoir fluid can be established by computer, saving elaborate laboratory work. Accurate values lead to much better reservoir analysis. Fig. 6.

ing large numbers of arithmetical computations are carried out on the digital computer. In addition, the analysis of complex problems, such as a combination drive complicated by gravity segregation, can be handled in a routine manner. Solution of such a problem with a desk calculator is impractical because of the prohibitive amount of time involved.

Decision Analyses

The recent developments in decision analysis, as a part of operations research, have created considerable interest in companies concerned with finding and producing oil. Some of the techniques are particularly interesting to those of us concerned especially with oil finding.

The oil-finding gamble . . . The search for crude oil is very properly regarded as a gamble. However, we know as a matter of fact that the use of scientific methods in general has improved the chances of finding oil, and that further improvement could be made with the aid of mathematical methods that would permit the use of more of the available data.

The oil-finding problem is one that is a challenge to the application of the most complicated methods of operations research. When enough drilling information has been obtained, we can get rough ideas about the average cost of finding oil and the relative merits of drilling in one area as compared with another. But, to decide scientifically where to drill, requires more elaborate mathematical techniques than the simple application of elementary statistical methods.

Developing strategy . . . As in an elaborate military campaign, so too in the oil-finding game, a company seeks to use those stratagems that will enable it to compete with its opponents with minimum risks and losses. In petroleum exploration a company's opponents are both nature and competitors; its target, the oil reservoir; and its intelligence system, scout tickets, drilling reports, and geological, geophysical and geochemical data.

The success of a company's exploration campaign depends not only upon the quantity and quality of information delivered by intelligence, but also upon how quickly and efficiently these data are processed and incorporated in the exploration program.

First the oil company has to identify the target area, usually a large zone of the order of 10,000 sq. miles, in which it is felt that oil is most likely to occur in commercial quantities.

After the drilling area has been chosen, a host of other problems arise. These result in part from the activities of competing oil companies and from the acquisition of desired parcels of land. The game becomes even more complex after the first well is drilled, when it becomes necessary to reevaluate the old scientific information in the light of newly acquired data. The problem is further complicated by the fact that we are not only playing a game in which nature is an adversary, but we also have competing companies whose stratagems and tactics are subject to change.

Matter of probabilities . . . Decision analyses for this type of problem are not simply and easily amenable to linear-programing techniques because the scientific information available is not in the form of linear relationships between, or among, the various parameters. Usually it is in the form of rather complicated probability functions, and some complex laboratory tests for the reliability of the functions have to be made.

As a result there is some question as to whether present mathematical methods are entirely applicable to the exploration problem. At least there is a question as to whether these methods are adequate at the present time for the entire decision problem of the petroleum-exploration venture.

At the present stage it appears that the magnetic-drum machines will be quite useful in dealing with small parts of the over-all problem, particularly those in which decisions can be based on discriminating probability functions. However, if we get seriously into the problem of multivariable control, even the most elaborate equipment now available may not handle the big over-all problem involving both the broad decision making and the detailed planning of drilling campaigns.

Despite the above qualifications and uncertainties, investigation of application of operations-research methods to oil finding appears worth while. Where these techniques fail to help us express the entire decision problem mathematically, we shall have to resort to less elaborate and more tractable analyses wherein certain assumptions have to be made about our over-all exploration strategy.

Acknowledgment

I wish to acknowledge the assistance of D. R. Shreve for the portion on the displacement of oil by gas, and to A. L. Hicks for the portion on water drive. I also wish to remark that Dr. John Von Neumann has had a very strong influence on the computing philosophy of our group, and hence on much that appears in this paper.

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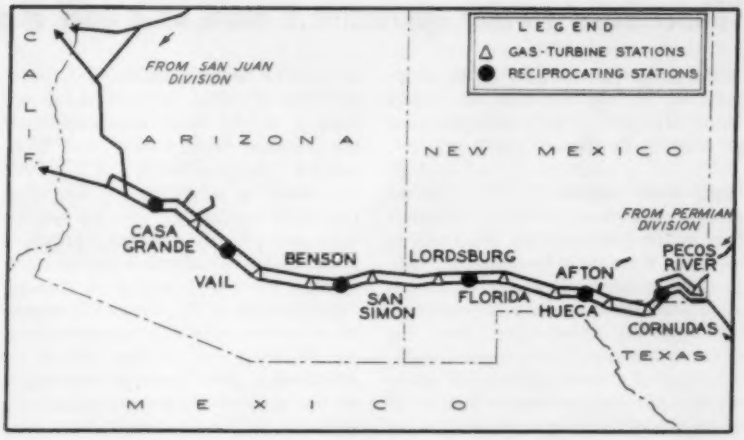

GAS TURBINES on El Paso line are first step toward automation.

El Paso Natural has taken the first of

Three Steps to Automation

in natural gas compressor-plant operation

By E. A. Walsh

PART 1

AUTOMATION has become so essential in most large-scale manufacturing and process industries that many could not survive in this competitive age without it. This is particularly true in cases where quality control, flow control, and mass production are economic factors. Today practically every new plant design in the automotive, steel, and chemical process industries is predicated on the use of automatic devices. This wide use of automation has fostered a development of a giant industry in itself. In addition, military applications of automation alone have demanded enough development engineering and production of these control devices to support a major industry. From this it is evident that, where we have an economical application, we can certainly find available a wealth of reliable equipment to start, stop, monitor, and control.

In natural-gas drilling, production, treating, transmission, and distribution installations there are numerous applications for automatic and remote-control devices. New design problems demand a decision of whether or not to go automatic.

There seem to be three separate phases involved, each of which justifies and paves the way to the next.

- Automation operation.
- Supervisory control.
- Unattended plants.

Automatic operation . . . The first phase, automatic operation, has been accomplished at El Paso Natural in the gas-turbine-driven centrifugal compressor plants. We have 10 of these plants involving twenty-eight 5,000-hp. units, which are push-button operated. Having completed 5 years of operation on these units, we will describe in Part 2 some of the automatic-operation features and related data of value to those considering the use of automatic equipment.

In the first phase we intended to accomplish the starting, stopping, monitoring, and control of the gas-turbine compressor units by mechanical, electrical, and pneumatic devices rather than manual. A certain reduction in the operating manpower was realized which we believe justified the additional expense of this automatic operation. We are now in the process of

Author is with El Paso Natural Gas Co., El Paso, Tex. Paper presented at spring meeting, Rocky Mountain District Division of Production, American Petroleum Institute, Casper, Wyo., under title, "Automation in Natural-Gas Compressor-Plant Operation."

The approach to automation . . .

For some time we have been aware of the possible economic advantages of automation in natural-gas compressor plants. In many cases we have installed and used to advantage certain types of this equipment, particularly in cases of gas turbines and small field-compressor units. Here we are not concerned with the small field units, but rather, with the automation of large (15,000 hp. or more) gas-compressor plants.

In this type of installation we believe that the application of automatic and remote-controlled equipment must be justified step by step in a long-range plan. We must have a plan that will help us enter the field of automation intelligently, one that will provide time for personnel training as well as time for evaluation of each phase. This approach may seem a bit tedious with the vast knowledge of automation available to us today; however, we believe that there is no such thing as a general or universal application of automation. The application must be developed and proved in each industry separately. Accumulation of these experiences will help those of us who are considering automation. Further, each company's application of automation is as different as its personnel, load factor, location, and communication system. For this reason, we are enthusiastically and deliberately following a step-by-step evaluation in our own company—the first step of which is the gas turbine we now have in operation.

This paper is divided into two parts. Part 1 outlines the present thinking of El Paso Natural Gas Co. on utilization and design of automatic and remote-control equipment in natural-gas compressor stations. Part 2 is a discussion of operating experience, to date, with the automatic gas-turbine-driven centrifugal compressor plants.

"Unattended station operation is more of a goal than a design consideration"

determining the reliability of the automatic equipment. When it has proved itself adequate, we will consider progressing to the second step.

Supervisory control . . . The second phase, supervisory control, demands two major prerequisites. First, as in all cases, there must be economic justification; second, there must be an adequate communication system to relay operating information from the plant to the supervisory-control point. Because of the complexity of many gas-transmission systems, a study will reveal that there is opportunity for increasing system efficiency by using supervisory control. An example of this would be as follows:

A computer system at a central control point could be continuously fed the various system pressures, flows, and other information related to the dispatching of gas. The equipment would continually supply the dispatcher with accurate information, which, in turn, would be transmitted back to the plants and various equipment in the system.

In this type of installation we would retain a full plant operating staff to accomplish station maintenance and general operating duties. We have only moved the control to a central point where modern computers can see a dispatching problem instantly and utilize the complicated system facilities to the best advantage. This type of installation can be done on a system basis, or in some cases, it might be economical to consider only part of the system, such as the satellite-plant idea. Sometimes small areas of a pipeline system are involved with constantly changing conditions of operation such as those found in gathering systems. Here a central point can monitor, control, start, and stop satellite units from the main-line plant. This phase is now under study at El Paso Natural and will more than likely be our starting point on supervisory control rather than the full-system type of operation.

Unattended plants . . . Phase 3, unattended plants, is the final step. This has been done with small stations in other companies, and to the best of my knowledge, has been successful. In entering into this phase for large-scale plant operation we have a problem that has not appeared until now. In this phase, we are concerned not only with reliability of control devices and communication system, but with the reliability and adaptability of the equipment which we are trying to control. If a company is to consider this phase of automation, we believe it should have assurance from the various prime-mover and compressor manufacturers that their equipment is adaptable to long-term operation unattended. We do not believe our present installed equipment is adaptable. Unattended station operation is more of a goal than a design consideration at this time. We believe maintenance requiring traveling crews would offset any savings offered by unattended plants, except, of course, in the case of small-horsepower stations or satellite stations.

PART 2

On September 29, 1952, the first of El Paso Natural's gas-driven centrifugal compressor stations began operation at Cornudas, Tex. This station is one of 10 intermediate booster stations installed between reciprocating plants on the El Paso Natural's southern pipeline system. The stations were equipped with twenty-eight 5,000-hp. General Electric gas turbines, driving single-stage centrifugal compressors supplied by Clark Bros. Co., De Laval, and Ingersoll-Rand companies. Station spacing is approximately 30 miles on the parallel 26-in. and 30-in. transmission system. The first project involved the installation of seven units to increase the line capacity 100 M.M.c.f. per day. The second project increased the line capacity an additional 200 M.M.c.f. per day by the addition of 21 gas-turbine units. To date, we have a total accumulated operating time of 600,000 hours on the 28 units. On the basis of this time in operation, the following information is presented.

Automatic control . . . Other than the new combination of prime mover and compressor, the plants departed from the standard design features in many ways. One outstanding feature was the completely automatic control. In a matter of minutes the plant can be put into service by energizing one master control switch. No outside source of power is necessary. The starting operation is initiated by the station battery and pipeline pressure, which is available. All controls, pumps, motors, etc., necessary for starting are d.c. Turbine is rotated by a small expansion gas turbine which requires about 45,000 cu. ft. per start. As the turbine is fired and reaches operating speed, the d.c. power is cut off and a generator driven by the turbine assumes the power load.

The compressor is pressurized and loaded by means of automatically operated valves, and upon completion of the startup sequence a discharge pressure controller takes over the speed control of the turbine and maintains a preset output. Once in operation a variety of sensing devices feel the pressures, temperatures, speeds, etc., throughout the station to insure safe operation and control. Any irregularity at control points is reported by an annunciator panel which rings an alarm and drops a tab identifying the source of trouble. If the trouble is of a serious nature, the plant will automatically be shut down and the gas will be bypassed.

In order to protect the control equipment, an air-conditioned control room was constructed of brick. This protection was particularly necessary in our locations where dust storms are prevalent.

Personnel . . . At present, the operating crew of such plants consists of a chief operator, maintenance repairman, and five operators. Originally, the plants were manned with one chief operator and four operators. After a short time of operation it was deemed necessary to add two operators. These figures compare with approximately 27 men required in a reciprocating, nonautomatic plant of this size.

Electrical, instrument, and building maintenance is performed by technicians located at strategic points over the system. These men accomplish maintenance for all stations—reciprocating and gas turbine. In only a few cases do we use specialized personnel on the automatic gas-turbine plants. One such is mechanical-turbine and centrifugal - compressor maintenance. For this we use a traveling crew of six men, trained in assembly and dismantling of this equipment. They move from plant to plant on a predetermined schedule and overhaul the units. We hope to arrive at a program which will involve a complete overhaul on each unit once every 3 years.

One of the most important factors in the operation of automatic equipment is the training of personnel. Long before ground was broken for the first station, a group of company engineers and maintenance men was sent to the factories of the equipment manufacturers. There they attended schools, witnessed construction, and assisted on tests. This group later formed the nucleus of an extensive training program for the operating personnel. When actual construction began at each station, the operating

crew was assigned to assist in the construction. This was very successful in producing competent operators who, literally, grew up with their stations.

In the early days of operation of the gas-turbine plants most of the failures occurred in the control devices. About 1 year was necessary in order to modify the equipment and arrive at reliable control systems. We now believe that the control devices for starting, stopping, and monitoring the gas turbine within the plant are satisfactory, and in most cases would be reliable enough for remote operation.

More recently the problem encountered in operation of the gas-turbine plants has become mechanical. We have undergone a series of modifications of the gas turbine and of the centrifugal compressor. These modifications were made to correct original design failures in the equipment. For this reason we are beginning all over again in our evaluation of the adaptability of this type of equipment to unattended station operation. The failures that have come in the past few years have certainly shown us that the equipment was not originally adaptable to unattended station operation; however, we have in recent months operated 15,000-hp. stations for periods of 1 to 1½ months without any down time whatsoever.

Comparative costs . . . Our original thought that operating automatic gas-turbine plants would be less expensive has certainly been realized. We have installed in the southern division approximately 140,000-hp. of gas turbines and approximately 140,000 hp. of the modern vertical-engine reciprocating-compressor units. Consequently, an easy and quick comparison is made on the basis of a fairly large amount of horsepower (see Table 1).

Cost per horsepower installed:

Gas-turbine automatic stations—$15.20.

Reciprocating-engine plants, nonautomatic—$20.84.

The foregoing figures represent the operating costs for 1956. With this in mind we believe we are safe in saying that our first experience with automation has been successful and definitely has justified itself economically.

The major variation between the reciprocating plants and the gas-turbine plants is gas cooling. Because of the low ratio of compression in the gas-turbine plants, we do not need aftercooling. This fact will seriously affect the comparison of operating costs and operating manpower required. However, we believe that an automatic reciprocating plant with gas cooling could be operated with the same savings in manpower realized in a gas-turbine automatic plant with gas cooling. Automatic operation is not limited to the gas turbine; however, at this time it seems that the gas turbine would be more suitable to supervisory and remote control than the reciprocating units because of the maintenance required of the reciprocating engines. This is fast being overcome by the manufacturers, and only applies to our present installed equipment.

TABLE 1—1956 OPERATION-DATA COMPARISON

	Gas-turbine stations	Reciprocating stations
Lube-oil cost per 1,000 hours	$0.22	$0.12
Maintenance cost per hp. installed	$2.62	$2.78
Fuel, cu. ft. per b.hp.-hr.	10.2	9.5
Operating cost per b.hp.-hr. developed	2.05	2.98
Load factor, per cent	103	87
Availability factor	99.4	99.7

Because of the isolated locations of the plants in our southern division system, it is necessary to provide housing facilities for the employes. In the case of automatic gas-turbine stations, the reduction in the initial plant-construction cost of housing facilities offers the additional cost of automatic equipment, and these plants were constructed at less cost than a similar reciprocating plant of the same horsepower.

Future possibilities . . . As was pointed out earlier we are presently studying the feasibility of supervisory control. At the same time, we are installing and have in operation microwave facilities in order to improve our communications system. We believe that by the time the supervisory-control idea is decided upon we will also have the required experience in communications systems.

Our pipeline system suffers from rapidly changing load conditions from packing to unpacking the pipeline. It is very hard for a dispatcher to get the feel of the system and anticipate requirements which utilize the equipment to the best advantage, particularly in our case where we have the 30-mile station spacing. Any pressure change on the pipeline is rapidly transmitted from one station to the next. It is somewhat like knocking down a row of dominoes when a plant goes off the line as a result of emergency failures. A centrally located computer which continuously monitored the plant information could immediately give us the most efficient operating points for the plants and automatically dispatch this to the plants. An example of this type of operation has been proved many times in the case of the electric-power industry, where a complicated network of power plants and feeder lines must be integrated to supply to the customer at the proper time with the utmost efficiency.

Automatic operation has definitely been an advantage and a success. Supervisory control is being considered and seems entirely reasonable some time in the near future. Unattended plant operation is nothing more than a goal, except in the case of very small horsepower units.

Nelson Refinery Construction Index

Appears in the Engineering Section in the first issue each month.
Compiled by W. L. Nelson, petroleum refinery consultant, Tulsa.
The Index was explained October 1, 1956, (page 110) as well as the Indexes of Individual Items of Equipment that appear on the Cost-imating page in the first issues of the months of January, April, July, and October.

Index (1946 = 100)

	1949	1952	1954	1955	1956	Feb. 1957
Pumps, compressors, etc.	135.9	155.6	166.5	172.2	192.0	203.3
Electrical machinery	130.9	152.4	160.0	162.5	175.0	191.1
Internal-combustion engines	124.8	146.5	150.5	153.2	164.0	169.0
Instruments	123.1	146.2	154.6	162.9	182.1	186.2
Heat exchangers	133.0	165.8	171.7	156.8	190.7	195.9
Miscellaneous equipment average	*121.6	153.3	160.7	161.5	180.5	189.1
Materials component	143.6	164.3	174.6	176.1	190.4	199.0
Labor component	137.1	163.1	183.3	189.6	198.2	203.5
Nelson construction index	139.7	163.6	179.8	184.2	195.3	201.7

*Used in computing the Nelson Index until April 1952. This is slightly different from the average of the Miscellaneous Equipment Items shown above.

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Rated Metering Capacity, BPD	300	300	500	500	720	720	1440	1440	2000	2000	4000	1600
Avg. Expected Metering Accuracy, Percent	99.01	99.80	99.22	99.90	99.44	99.95	99.56	99.97	99.75	99.98	99.75	99.98
A Shell and Base O.D., Inches	16"	18"	20"	24"	24"	24"	30"	30"	36"	36"	48"	48"
B Length of Dump, Inches	12.62"	17¼"	16.06"	20⅞"	22.20"	31⅛"	28.20"	38¾"	49.00"	60²¹/₃₂"	55.00"	60²¹/₃₂"
C Overall Height, Inches, Approx.	35¾"	48"	43⅞"	53"	51½"	64½"	63⅞"	75"	88¾"	98"	17"	98"
D Center Line Height of Valves	6"	6"	7"	7"	7"	7"	8"	8"	8"	8"		8"
E Center Line of Unit to Face of Inlet & Outlet Valves, Inches, Approx.	8"	8"	13"	13"	13"	13"	15"	15"	18"	18"		18"
F Size of Inlet & Outlet Valves, Inches (Standard)	1"	1"	2"	2"	2"	2"	3"	3"	3"	3"	4"	4"
G Gas Equal. Conn., Inches	1"	1"	2"	2"	2"	2"	3"	3"	3"	3"	4"	4"
H Height of Upper Liquid Level, Inches	28"	35¹/₁₆"	34⅞"	40²¹/₃₂"	41¾"	52"	51¾"	62¹/₃₂"	74½"	85⅝"	86⅞"	94¾"

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By W. L. Nelson
Technical Editor

QUESTIONS ON TECHNOLOGY

Changes in Gas Processing

What obsolescence is expected in the natural-gasoline industry?—R.P.C.

Three of the problems facing the natural-gasoline industry today are (1) octane upgrading of natural gasoline so that a refiner's gasoline pool is not degraded, (2) the transportation (and recovery) of more propane, butane, and ethane as charge stocks for chemical manufacture, and (3) the supplying of isobutane for alkylation plants. These problems cannot be solved cheaply or easily.

The four major illustrations of obsolescence in natural-gasoline or gas-processing operations (see Table 1) have been:

1928 Absorption process
1935 Catalytic polymerization
1940 Recovery of propane, etc.
1955 Alkylation

In addition, at least 16 significant changes or improvements in gas processing have occurred and some of these have involved large sums of capital, especially the recovery and retention of isobutane, ethane, and larger amounts of propane. Most of the changes, however, affected only segments of the industry.

Serious obsolescence in gas processing is not visualized but parts of the industry will continue to be affected by the continuing need for hydrocarbons for chemical manufacture.

RECOVERY AND PROCESSING OF GASES

The deliberate recovery of casing-head gasoline from field gases was first reported in 1903 when rich gas was passed through coils cooled with water. Compression was applied in 1905, rapid development occurred after 1909, and very rapid growth during 1916-1917.

The absorption of liquid components from natural gas first attracted attention in 1912 and a packed tower (stone) was used in the stripping still. Absorption in the most direct sense was employed (The Oil and Gas Journal, November 2, 1933, page 36), namely, a series of 10 historical vessels arranged one above another so that the oil could flow downward from one vessel to another. By 1923 about one-fourth of the natural-gasoline plants were of the absorption type and during 1926-1931 the production of natural gasoline increased fortyfold. At the same time (1926-1932) the Seaboard (sodium carbonate), Koppers (sodium phosphate), and Girbotol (diethanolamine) defulfurization processes for removing hydrogen sulfide were fully developed. Stabilization was first accomplished by weathering in open tanks or vessels, but by 1930 high-pressure fractionaters (stabilizers) were extensively

Compression process (1916)
Thermal polymerization (1932)
Stabilizers (1930)
Catalytic polymerization (1935)

used and bottle gas (propane) was marketed. By 1938 and during the war, stabilization had been extended to the separation of several hydrocarbon products including especially isopentane for incorporation into aviation gasoline.

Isopropyl alcohol was the first major petrochemical product. Commercial manufacture was initiated in 1919-1920 by the Standard Oil Co. (N. J.). The Gyro vapor-phase cracking process was applied in 1928 to the production of gases for chemical manufacture, and by 1938 the process had been applied to hydrocarbon feed stocks. The same process is used today for the production of ethylene and olefinic gases by thermal cracking.

The thermal cracking of gases and their thermal polymerization was developed extensively during 1928-1940, but the catalytic polymerization process was most widely used after 1937. The reduction of hydrogen sulfide to sulfur attracted attention in 1940 but such processes were not widely used until after 1950.

Alkylation was needed during the war for the production of aviation gasoline but it was not used extensively for the production of motor fuel until after 1953. Now (1957) due to the advancement of octane numbers to 100, alkylation is tending to make obsolete the catalytic polymerization process.

Adsorption was used briefly after World War I for the recovery of liquid hydrocarbons from gas. Early plants were of the batch type, but in 1946 interest again turned to adsorption with the development of the continuous process called Hypersorption.

Natural gasoline and the bottle gases are still stored and shipped in pressure containers but atmospheric (refrigerated) storage is being investigated. Natural gas was liquefied on a commercial scale before 1940 and kept in refrigerated atmospheric pressure storage but after a serious fire, developments were discontinued. Interest arose again in about 1950, and at the present time several groups are investigating the liquefaction and shipment of liquid natural gas in barges and tankers.

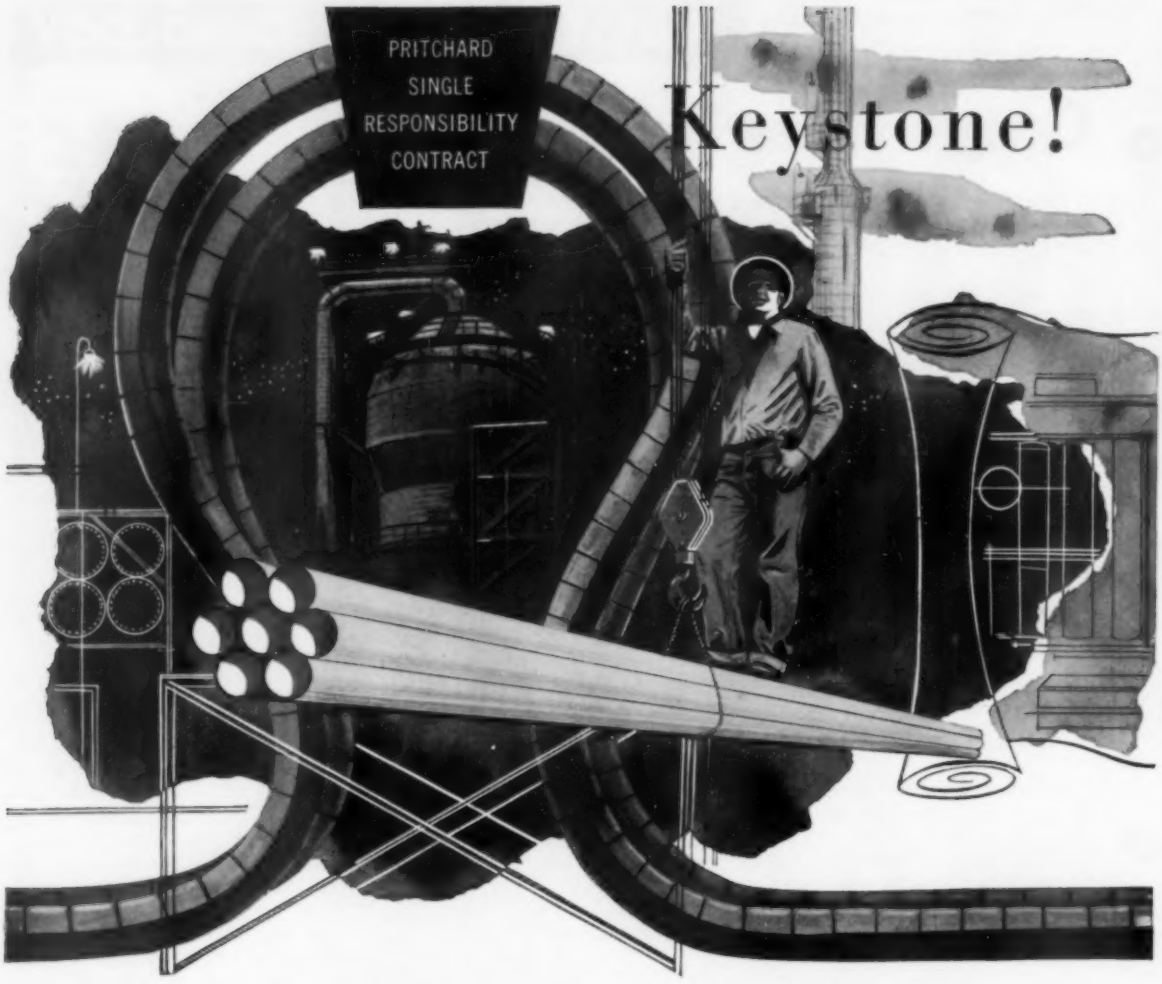
Viscosity of Gas At High Pressure

We are trying to estimate the viscosity of natural gas at 1,000 psi. from the charts in your Refiners Notebook No. 185, February 26, 1948, but the curves rise too steeply for extrapolation. How can we obtain such data? T. S.

As the pressure is increased at temperatures below or near the critical temperature, the viscosity of the gas rises very rapidly—approaching that of a liquid. In such situations the viscosity must be computed as indicated on pages 163-167 of the third edition of Petroleum Refinery Engineering, McGraw-Hill Book Co., Inc., New York, 1949, by the use of reduced temperature, pressure, and viscosity. At 60° F. and 1,000 psi., the rich gas of Refiners Notebook No. 185 (Feb. 26, 1948) would have a viscosity of about 824 micropoises.

TABLE 1—CHRONOLOGY OF GAS PROCESSING

1903	Casing-head gasoline collected
1905	Compressors employed. Product was weathered
1912	First absorption operations
1913	Use of stone packed towers in strippers
1915	Ammonia refrigeration absorption
1916 (1909-1921)	Compression gasoline process
1920 (1918-1923)	Adsorption recovery of gasoline
1923 (1912-1931)	Absorption process developed
1923 (1919-)	Isopropyl alcohol
1928 (1926-)	Absorption process dominant
1928 (1926-)	Desulfurization of gases
1928 (1927-1945)	Gyro vapor phase cracking for gases
1930 (1927-)	Stabilizers (high pressure fractionators)
1932 (1928-1940)	Thermal (cracking or) polymerization
1935 (1930-)	Recovering propane in stabilizer
1935 (1933-)	Catalytic polymerization
1938 (1934-)	Gas cracking for ethylene, etc.
1940 (1938-)	Separating several hydrocarbons
1940	Liquefaction of natural gas for storage
1943 (1942-)	Separation of isopentane
1943 (1942-1948)	Alkylation for aviation gasoline
1950 (1940-)	Sulfur recovery from hydrogen sulfide
1950 (1946-)	Hypersorption continuous adsorption
1954 (1951-)	Catalytic reforming of natural gasoline
1955 (1953-)	Alkylation for motor fuel
1955 (1943-)	Isomerization of butane
1956 (1948-)	Shipment of liquefied natural gas



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REFINER'S NOTEBOOK

Storage Stability

A Study of Blended-Fuel Deterioration

By F. G. Schwartz and C. C. Ward

DURING the last 10 years the demand for all petroleum products has increased with a disproportionate increase in demand for the middle distillates. These middle distillates supply diesel fuel, jet fuel, domestic-burner fuel, and catalytic cracking charge stock. A straightrun distillate is preferred for all of these products but the supply of straightrun distillate has not been adequate to meet the increased demands. For many uses it has been necessary to make up the deficit by blending catalytically and thermally cracked stocks with straightrun distillate. This blending of fuels had complicated the storage problem as some of these blended fuels deteriorate under normal storage conditions.

Gum Formations

The formation of gum in fuels upon storage is a problem of long standing. Gum is formed in two physical states: One type is dissolved in the fuel and cannot be filtered from it but can be recovered by evaporation of the fuel; this dissolved nonvolatile material is called soluble gum. It is thought to be undesirable in fuels because it may be precursor to formation of insoluble gum, and soluble gum as such may contribute to injector striking and engine deposits.

The second type of gum exists as a precipitate in the fuel. The material is insoluble in the fuel and contributes to filter clogging and to fouling of the fuel-injection systems of engines. This material is designated usually as "insoluble gum." It is believed that insoluble gum is the more harmful product of fuel deterioration in storage.

Authors are with Petroleum Experiment Station, Bureau of Mines, USDI, Bartlesville, Okla. Complete report, "Distillate Fuel Storage Stability," available from Western Petroleum Refiners Association, Hunt Building, Tulsa, for $2.

W.P.R.A.-Bureau of Mines Program

Storage - stability studies, jointly financed by the Western Petroleum Refiners Association and the Bureau of Mines, were begun at the bureau laboratories in Bartlesville in May 1951. Subsequently the Bureau of Ships, Navy Department, contributed funds to expand and expedite certain phases of the work relating to the causes of instability.

Although the work has emphasized the complexity of the general stability problem and the lack of knowledge about storage stability of fuels, some fairly definite facts are becoming evident, and clues as to the causes of fuel deterioration give hope that eventually the problem can be solved.

Objectives . . . The Bureau of Mines-W.P.R.A. cooperative program has two general objectives:

1. To obtain storage-stability date on distillate-fuel samples that are representative of crude-oil sources from the major producing areas, both domestic and foreign, and that differ widely in respect to storage-stability characteristics. The samples include straightrun, catalytically cracked, and thermally cracked fuels, prepared from the same crude source whenever possible.

2. To determine causes for instability in distillate fuels.

This report summarizes information derived from storage of 34 fuels and 250 blends, stored at several distinct conditions, to meet Objective 1 of the program.

Scope of Work

Through the cooperation of refiners in general, and particularly the members of the W.P.R.A., 13 straightrun fuels, 9 thermally cracked fuels, and 12 catalytically cracked fuels that met the previously stated conditions were obtained.

The fuels were representative of the following areas of domestic production: western Mid - Continent, eastern Mid-Continent, Gulf Coast, West Texas, California, Rocky Mountain, and Scurry County, Texas. Foreign production areas from which fuels were obtained were: Middle East, Venezuela, Mexico, and Canada. Many of the fuels were produced from mixed charge stocks, so that precise definition of the producing areas is impossible. The treatment history of the fuels is admittedly incomplete but is all the information available.

Bureau of Mines–W.P.R.A. program . . .

In this Refiner's Notebook series, a report is presented on the Bureau of Mines-W.P.R.A. program on storage stability of distillate fuels and blends. This program was developed with two general objectives; the first was to find fuels that are unstable and blends of fuels that are incompatible in storage, and the second was to study the fundamental causes for instability.

Storage stability tests of 34 fuels and 250 blends were completed to meet the first objective of the program. The work accomplished on this phase of the program is described in this report. A number of conclusions are drawn concerning the relative stability of fuels and blends, effects of variations in blending, and the relative severity of several forms of storage.

No attempt is made to present conclusive answers to specific stability problems; however, information is presented that may assist other investigators to solve or minimize stability problems.

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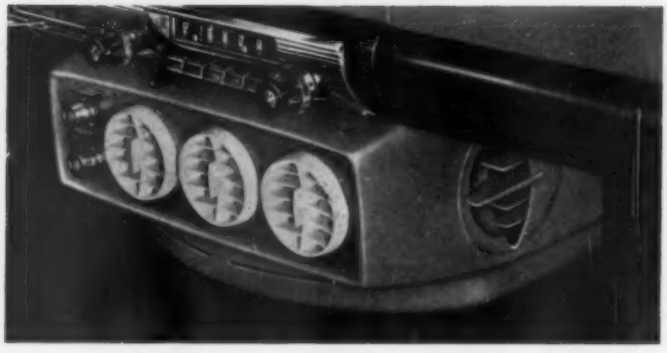

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By E. C. Mannas

Packaged Compressors

Part 1

Engine Compressors Go Modern

THE packaged engine compressor of today is a streamlined unit which operates at 300 to 1,200 r.p.m. as a replacement for the old one and two-lungers which operated at 100 to 150 r.p.m. The development of air-cooling sections used for removing heat from the jacket water, lubricating oil, and compressed gas replacing water-circulating tanks, spray ponds, and cooling tower also helped make the present compact units.

Compact unit . . . The modern engine compressor has three to four times the brake horsepower of the older units of about the same weight because of higher operating speeds and increased engine-compression ratios. This permits use of a high-horsepower compact unit that may be installed on a skid which can be moved about by railroad or truck. The units are also balanced for mechanical vibration by counterweights on the crankshaft. This offsets the moments of inertia of the compressor cylinders. On some engines installation of scavenging air cylinders opposite the compressor cylinders balances the unit. This reduced vibration permits the skid-mounted unit to be installed in the field on a small cement mat.

With development of turbo-charged engines, even higher horsepowered units are expected to be available for skidding and one manufacturer is now testing a skid-mounted 1,000-hp. turbo-charged unit.

The replacement of water cooling by a light compact air-cooling section permits the total cooling section to be installed either on the engine skid or on a separate skid with the fan (used for moving the air over the radiator or finned tubes in the air-cooling section) being driven from the engine compressor by belts or a hydraulic motor. The early models had trouble with the hot air from the cooling section recirculating when the wind direction was against the fan's movement of the air; however, recent trends show that scoops used to turn the air up and horizontally installed sections have eliminated this problem.

Author is regional manager, natural gasoline, Continental Oil Co., Oklahoma City.

Wide selection . . . There are many types and variations of packaged compressors on the market. A wide selection is offered from which to choose the proper unit for an installation. The units vary in size from 50 to 660 hp.

A survey of the cost of the various units indicates that the smaller units are as much as $30 per horsepower higher than the larger units. The price for all units of about the same horsepower are almost equal.

In some units the compressor operates directly off of the engine crankshaft. These are called direct-driven compressors while other units drive the compressor from belts connected to sheaves on the engine and are called belt-driven compressors. The direct-driven units usually operate at 400 to 600 r.p.m. while the belt-driven engines operate at 900 to 1,200 r.p.m. with the compressors operating at the same speed as the direct-driven units.

One manufacturer has recently offered direct-driven high-speed units with ratings up to 200 hp. By using a short stroke, the compressor-piston speeds of these units is maintained at the same speed as the slower speed direct-driven units.

Package compressors usually consist of an engine compressor, air-cooling section, gas scrubbers, and operating controls permanently mounted on one or two skids. Examination of the cooling section will reveal three cooling sections for the jacket water, lubricating oil and compressed gas. Sometimes the jacket water and lubricating oil sections are behind one another as the air temperature rise across these sections is only 3° to 5° F.

Scrubbers . . . Two to four gas scrubbers may be placed on the skid depending on the stages of compression. All scrubbers are usually equipped with liquid dump valves and high-liquid-level shutdown switches and the final stage scrubber, in addition, usually has a pressure-relief valve. Pressure gages for the suction intermediate and discharge pressure are mounted on a panel board on the skid. The engine compressors are equipped with shutdown controls for overheat, low oil pressure, overspeed, and vibration. Other controls such as a shutdown for high gas temperatures, in event of valve breakage; a tachometer, etc., may be obtained at an additional cost.

Cost

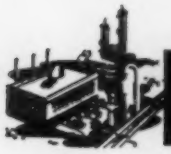
The cost of packaged compressors varies from $170 to $200 per horsepower, depending upon the horsepower of the units and the compression pressures. This may appear to be high, when compared to the cost of stationary units which cost from $100 to $120 per horsepower, but the cost of the packaged compressor includes not only the cost of the basic engine compressor but also the cost of coolers, scrubber, controls, and some of the piping.

The field installation of a packaged compressor requires only the laying of a flat inexpensive concrete mat to support and tie the skid down and the connection of gas suction and discharge lines. Present field installation cost of a large unit is about $7,000 or total cost of the packaged compressor, concrete mat, and piping is at present approximately $180 per horsepower. Similar installations of stationary units have cost as much as $275 per horsepower.

In the past, it has been the industry's practice to wait until an oil field is completely developed and production history is obtained to estimate the rate of gas production and the gas reserves before installing engine compressors to boost the gas.

Studies of oil-well gas reserves in the Oklahoma City region for the installation of compression facilities indicate a life of 15 years is about the maximum to be expected and in many smaller fields the life may only be 5 years.

Fluid Flow
Part 2



THE FOREMAN'S PAGE

Refining • Petrochem • Natural Gasoline

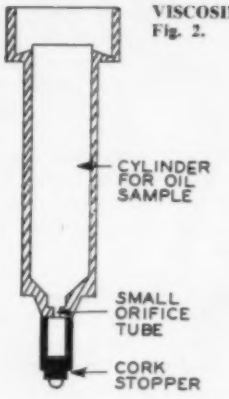
JOB IMPROVEMENT FOR THE PROCESS FOREMAN—91

Determining the Viscosity of a Fluid

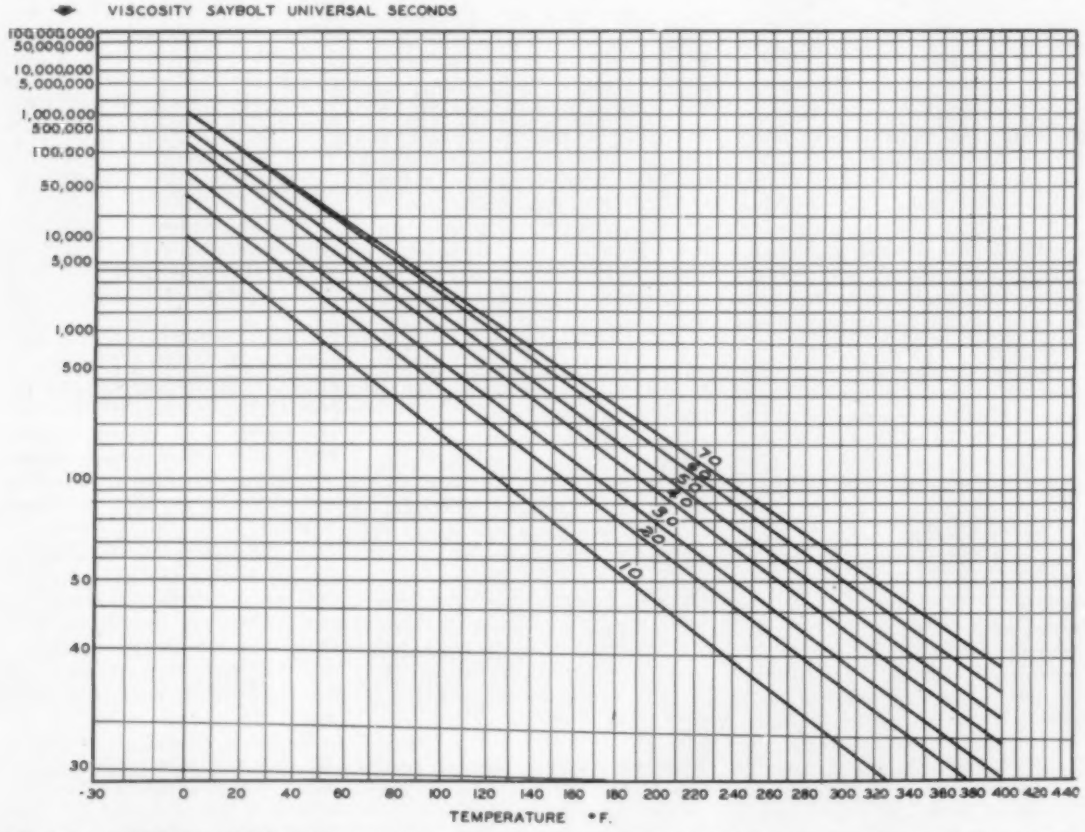
THE VISCOSITY of a liquid is determined in a piece of laboratory equipment called a viscosimeter. Fig. 2 shows a viscosimeter tube. This tube rests in a thermostatically controlled bath that holds the oil sample at the required temperature. This temperature is usually set at either 100° or 210°F. With the sample tube filled and the oil heated to the required temperature, the cork stopper is pulled and the oil allowed to run out of the cylinder. The time in seconds that is required for the oil sample to flow through the small orifice tube is called the viscosity of that particular sample. The viscosity of any fluid decreases rapidly with temperature. For this reason many heavy oils, especially the more viscous ones are either maintained hot or are heated to make pumping easier.

Fig. 2a shows variations of oil viscosities with temperature.

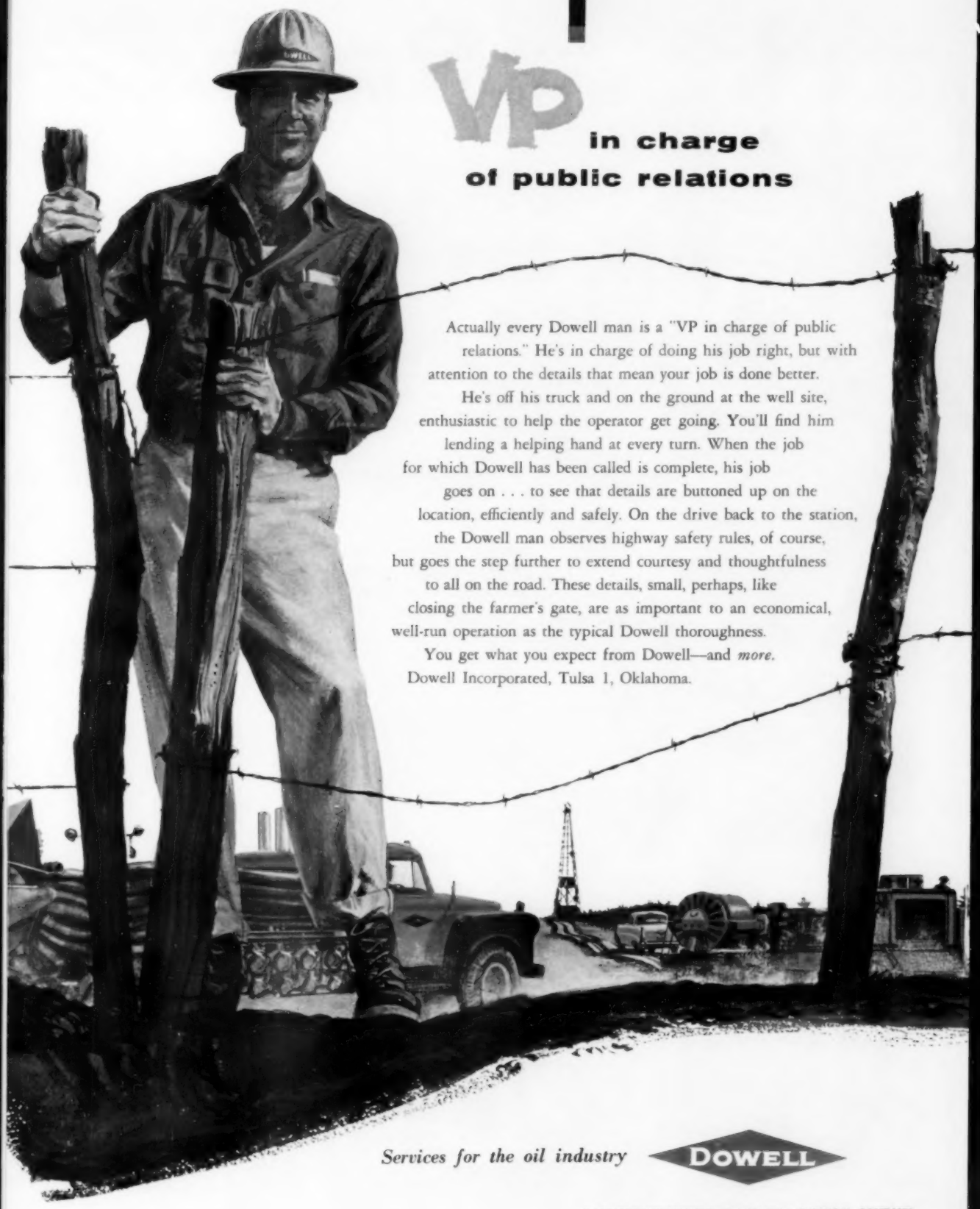
This material taken from process-training-program manual, Baton Rouge, La., refinery of Esso-Standard Oil Co.



VISCOSIMETER tube. Fig. 2.



SAYBOLT UNIVERSAL VISCOSITY of A.S.T.M. tentative viscosity-temperature charts for liquid petroleum products. Lubricating-oil S.A.E. ratings as shown. Fig. 2a.



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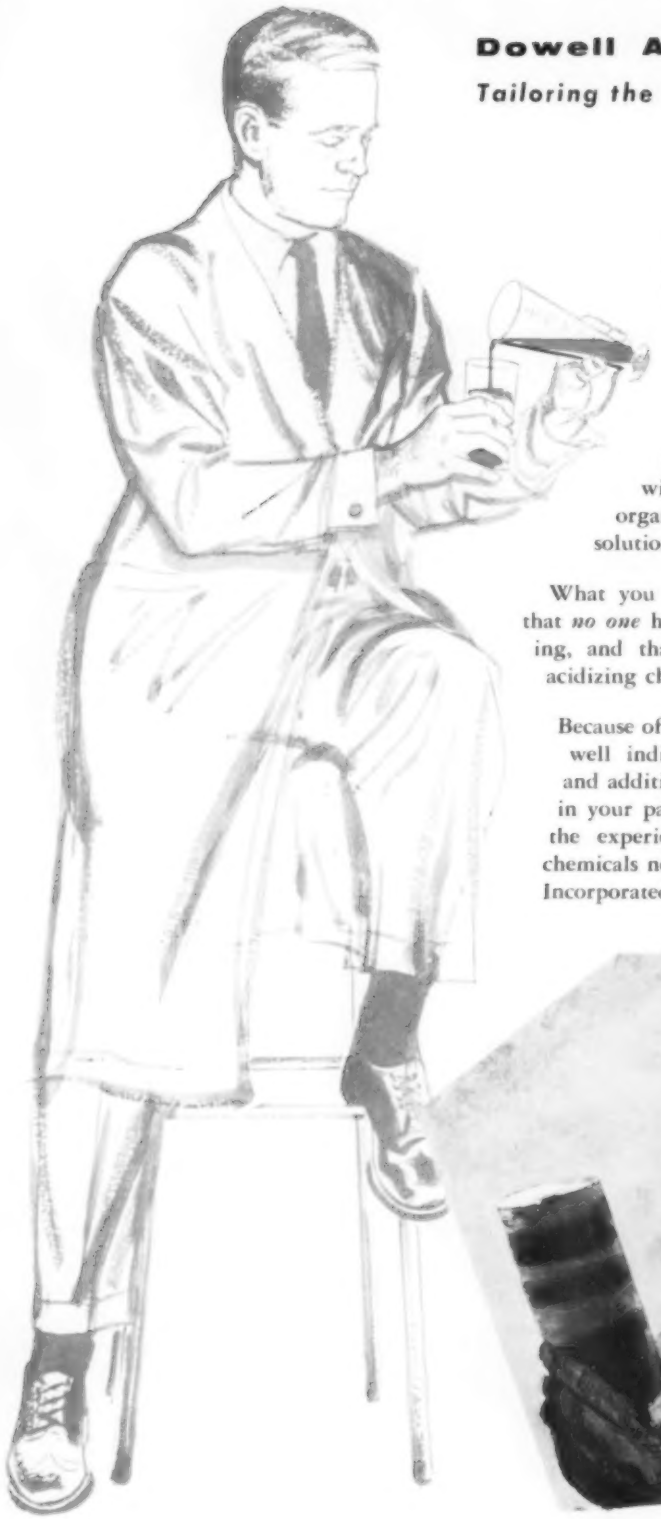

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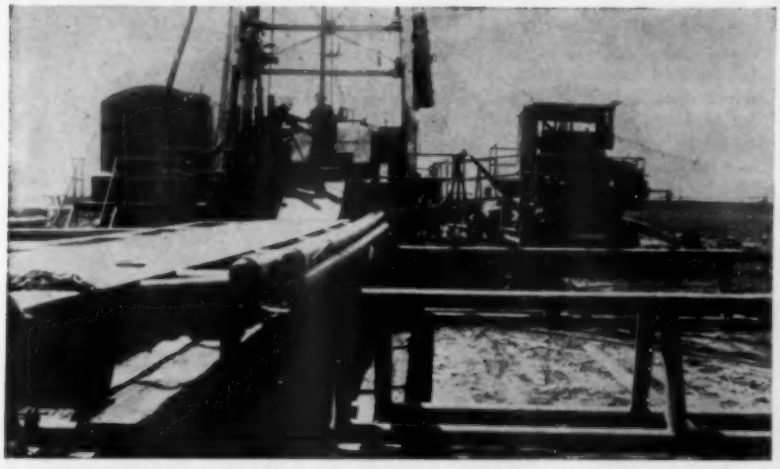
Drilling Contractors



FAST DRILLING trailer-mounted rotary rig operated by J. E. Miller Drilling Co., Abilene, Tex. Second trailer (right) carries rig's slush-pump and engine unit.

Trailer-Mounted Rig Makes Fast Drilling-Time

A trailer-mounted rotary rig owned by J. E. Miller Drilling Co., of Abilene, Tex., has drilled 94 wells, totaling 190,178 ft. of hole, in 591 days of operation.

Depths of the wells, all in the Abilene district, ranged from 1,500 to 3,500 ft. They averaged 2,023.27 ft. Drilling averaged 322 ft. of hole per operating day, including moving and rigging-up time.

Miller purchased the rig in 1955. In that year it operated 254 days, completing 43 wells with 82,132 ft. of hole. During 1956, operating 277 days, it drilled 40 more wells and 88,359 ft. of hole. In 60 days of operation this year, it has added 11 wells with 19,687 ft. of hole.

The rig is a National T-8-S assembly. It uses a single-drum draw works, the smallest made by its manufacturer. Power is supplied by a Waukesha 145 GKU engine. The trailer, built by Phillips & Son welding shop, at Abilene, carries an 87-ft. mast, raised and lowered by Vickers hydraulic raising cylinders.

The rig's slush pump, and the WAK engine which powers it, are mounted on another trailer. Pipe and other equipment make up three additional truck loads. The drill-string is 3½-in., 13.30-lb. pipe with six 6-in. (o.d.), 31-ft. drill collars.

Miller put another trailer-mounted rig, using a National T-12 single-drum draw works, in the field during June 1956. In 191 days of operation, it has drilled 24 wells with 52,751 ft. of hole. In this, it has averaged 276 ft. of hole per operating day. Depths ranged from 1,500 to 4,000 ft., averaging 2,197.9 ft. This rig is drilling with 4½-in., 16.60-lb. pipe with ten 6-in. (o.d.), 31-ft. collars.

J. E. Hillier is contractor on a 6,500-ft. wildcat test Ewing A. Branham, of San Antonio, is starting in the Richardson area, 20 miles southwest of Benavides, in Duval County, Southwest Texas. The operation is carried as 1 Richardson. Location is in GB&CNG Survey 5.

Glasscock-Wilson Drilling Co., Shreveport, La., has a new contract operation in northern Iberville Parish, South Louisiana. It is a 10,500-ft. exploratory test for H. L. Hawkins, of New Orleans. Location, at 1 Angelloz, in 41-7s-10e, is 15 miles west of Baton Rouge. It is about 2¾ miles east of Rosedale field, and about 3 miles southwest of Erwinville field, in West Baton Parish.

Vierson & Cochran, Okmulgee, Okla., are contractors on a 6,000-ft. wildcat test Carter Oil Co. is under-

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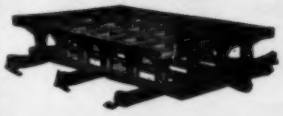

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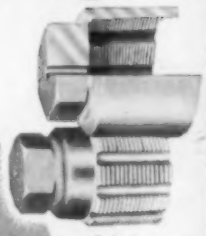

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taking on Pine Ridge anticline in Logan County, West-Central Arkansas. Location is 3 miles southeast of Ratcliff on Carter's McVay lease, in 22-7n-27w.

Ray Bedingfield, Shreveport, is well along on the first of two 5,000-ft. tests he has contracted to drill for G. J. Shinn, of Magnolia, Ark. Locations are off the north flank of Stephens field, in southeastern Nevada County. Current operation is about ¾ mile out from production. It is Shinn's 1 Federal Land Bank-T. L. Daniel, in 1-15e-20w. The second job, 1 Williams, in 2-15s-20w, is southwest of the first and at the edge of the old producing area.

Jet Drilling Co., Denver, is drilling a 6,100-ft. Paradox test for Carter Oil Co. in the Bluff Bench area, in San Juan County, southeastern Utah. Location, a wildcat, is 3½ miles west of Bluff field. It is Carter's 3 Bluff Bench, in 26-39s-22e.

Johnson Drilling & Service Co., Magnolia, Ark., is drilling for Sunray Mid-Continent Oil Co. at a wildcat location a mile east of Manice Bayou, in Lafayette County, southwestern Arkansas. It is a 6,600-ft. Travis Peak test at 1 Wheat, in 14-18s-25w. Location is 2 miles west of Canfield, and about 6 miles north of Bradley.

Richard Drilling Co., Corpus Christi, is on a new contract operation 11 miles south of Tilden, in McMullen County, Southwest Texas. It is a Wilcox test for Rodney DeLang and O. Neathery, Jr., at 1 Brown, in the Sidney Sherman Survey. Permit was taken out for a depth of 8,100 ft.

Dixie Drilling Co., Dallas, has taken on a 16,000-ft. wildcat operation in northern Vermilion Parish, Coastal Louisiana. It is to drill for Seaboard Oil Co., whose location, at 1 Villien, in 11-11s-3w, is slightly less than 2 miles southwest of its Maurice field. This field, opened early in 1956, has two gas-condensate wells with production from 11,300-ft. sands.

Big Chief Drilling Co., Oklahoma City, has the contract for an 11,000-ft. Smackover test Pan American Petroleum Corp. is putting down 2½ miles south of Farmerville, in Union Parish, northeastern Louisiana. Location, at 1 T. L. James & Co., in 8-20n-1e, is 13 miles west of Smackover production in the old Monroe gas area, and about 14 miles southeast of Bernice field, nearest other Smackover production.

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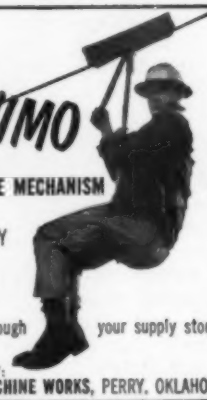

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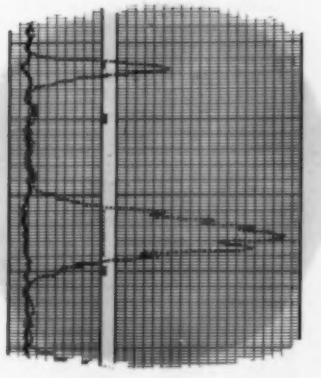

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It may not replace conventional methods but . . .

Dry ice works as a welding plug

By J. D. Lewis

SINCE the development of the acetylene torch and electric welding, the pipeliner has had to face the problem of keeping the flammable contents of his lines away from the acetylene flame and electric arc while making line repairs. The natural-gas pipeliner has developed the science of purging with inert gases and also cutting and welding hot or under fire. The oil pipeliner has favored plugging the lines off with muds or other materials to seal off the flammable contents of the line from the welding area. These methods have withstood the test of time and will give good results when used together with proper safety planning.

Pipeline welding plugs made from rotary mud, fire clay, asbestos, or clays and muds taken from the spoil bank, have the disadvantages in some cases or damaging such pipeline equipment as block valves, strainers, meters, pump valves, and mechanical seals. This type of plug can also contaminate products or cause wax plugging if used in badly waxed lines. Weld couplings are a good solution to the problem of tying-in lines but have the disadvantage of being expensive and occasionally difficult to install when lineup troubles are encountered.

Wax plugging . . . It became necessary for Standard to cut a badly waxed 8-in. oil line at several places for relocation and replacement at a time when weather and the work schedule would not permit dewaxing the line. Severe wax plugging was encountered after some of these cuts, presumably from the use of mud plugs. These circumstances pointed up the need for an effective welding plug which could be completely dissipated before putting the line back in service.

Carbon dioxide in the vapor phase is being used by natural-gas pipeliners for purging lines, but no written reports could be obtained regarding the use of solid CO_2, or dry ice, as a type of plug for oil-line repairs. It was felt that before we could safely use dry ice inside of an oil line, we should obtain:

1. Complete data regarding the physical properties of CO_2 and also the flammability limits of petroleum vapors in a CO_2-air atmosphere.

2. A shop trial which would permit visual observation of the behavior of the dry ice inside the pipe while trimming and welding, and also determine the time required for dissipation while applying heat to the outside of the pipe.

3. A method of testing the vapors in the line behind the dry ice for flammability to be certain that trimming and welding on an actual line could be done safely.

CO_2 is colorless and odorless in the gaseous state, colorless in the liquid state and dense, dry, and brittle in the solid or "dry ice" state.

Specific gravity as a gas @ 60°F. and atmospheric pressure referred to air, 1.519.

Density as a gas @ 60°F. and atmospheric pressure, 0.116 lb. per cu. ft.

Specific gravity as a solid @ —110°F. and atmospheric pressure, 1.56.

Density as a solid @ —110°F. and atmospheric pressure, 95.52 lb. per cu. ft.

Temperature as a solid, —110°F.

Critical temperature (above which CO_2 cannot be liquified by pressure alone), 87.8°F.

Critical pressure (under which CO_2 will exist as a gas in equilibrium with the liquid at the critical temperature), 1066.3 psia.

Therefore, a standard 50-lb. CO_2 syphon cylinder contains approximately 35 lb. of liquid and 15 lb. of expanded vapor and contains a pressure of approximately 860 psia. at 70°F. For practical considerations, it is found that 1 lb. of liquid or solid CO_2 will yield approximately 9 cu. ft. of vapor at atmospheric pressure and 70°F. temperature. It should be noted that solid CO_2 at atmospheric pressure does not melt, but rather evaporates or sublimes directly to a vapor.

Suppression of flammability . . . Since carbon dioxide is an inert gas, its addition to a petroleum vapor-air mixture in sufficient quantity causes dilution of the air and removes the mixture from the flammable range. For example, any mixture of air and gasoline vapor can be made noncombustible by the addition of 29 per cent of CO_2 and any butane-air mixture made noncombustible by the addition of 28 per cent of CO_2.[2] There are no petroleum vapors requiring a concentration higher than 32 per cent CO_2 to render them nonexplosive, but since stratification of vapors and other unknowns could be present, the Navy regulations and American Bureau of Shipping recommendations call for a concentration of never less than 50 per cent CO_2 while hot work is in progress on CO_2 inerted tanks.[3]

Shop trial . . . All pipeline repair work requires that safe procedures be used to avoid hazards to both employes and the public. Proper safety planning of the work to be done is the only safe way to proceed. This safety planning was especially important to us when planning to use an unknown procedure of pipeline repair. We therefore felt that a shop trial would be necessary to furnish the required experience and data for safe planning of an actual field trial.

Accordingly, a dry run was made at our welding shop using two pieces of 8-in. pipe, each 5 ft. long, to be trimmed and welded together like an actual pipeline tie-in. Dry ice was obtained, pulverized into a snow and approximately 35 lb. of this material packed into each piece of pipe in an attempt to form a plug. These quantities of CO_2 were about 18 in. long, and their outside ends were placed about 9 in. from the ends to be welded.

The pipes were then trimmed and

Author is with pipeline department, Standard Oil Co. of California, Western Operations, Inc. Paper presented at the pipeline section Western Oil and Gas Association, Southern California Industry Safety Conference, April 17-18, 1957.

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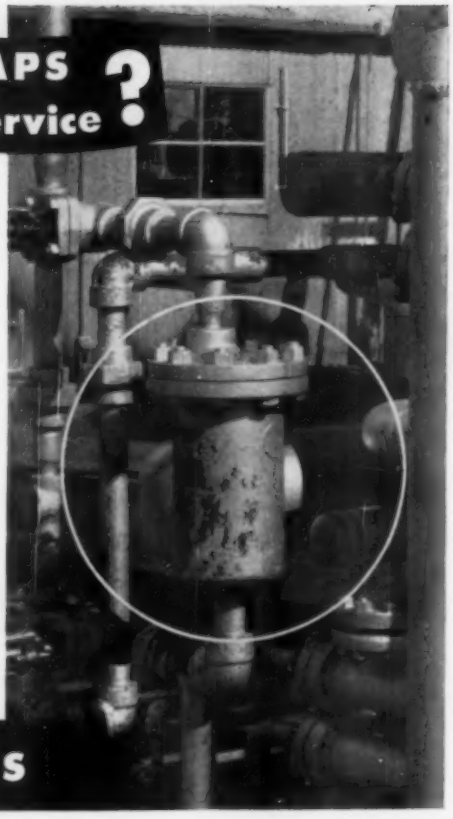

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The Oil and Gas Journal
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bevelled with an acetylene torch and arc welded together using three passes. Cutting and welding consumed 30 minutes of time, during which CO_2 vapor poured continuously from the open ends of the pipe. However, no appreciable volume of the dry ice was dissipated during the welding, so the pipe was heated on the outside with a large tipped acetylene welding torch for 35 minutes to completely thaw one end of the pipe. Ambient air temperature during the experiment was 57°F.

It was noted during this shop trial that the pulverized dry ice did not pack into a tight plug, but rather just laid in the pipe as any dry, coarsely granulated solid might do. Dissipation resulted in a settling of the dry ice, leaving a crescent-shaped gap between the top of the material and the upper pipe wall. Although a thick layer of frost accumulated completely around the outside of the pipe opposite the CO_2, the dry ice inside did not freeze to the pipe walls, but rather stayed loose. This is understandable when it is realized that the periphery of the dry ice at atmospheric pressure sublimes directly to CO_2 vapor due to absorption of heat through the pipe walls. These observations indicated that the dry ice would not be effective for holding any pressure or much hydrocarbon liquid out of the welding area.

Practical considerations . . . It was noted during the shop trial that the dry ice should be kept at least 18 in. from the ends of the pipe to minimize the cooling effect on the welding operation. Also, since the impact strength of steel is greatly reduced at subzero temperatures, and since the temperature of a portion of the pipe wall probably approaches the —110°F. of the dry ice, it would seem prudent to prohibit any heavy pounding or jarring of the pipe.

Dry ice should not be handled with bare hands, and pulverization should be done by putting it in a burlap sack and pounding the sack to prevent particles from flying about. If it is pulverized in an open container, the workmen involved should wear goggles and keep their clothing tightly buttoned so that particles cannot get next to bare skin and cause frostbite. The pulverized dry ice should be placed in the pipeline with a shovel to avoid handling with the hands.

Although CO_2 is not considered a toxic gas, it is heavier than air and large quantities in a bell hole could conceivably cause suffocation of personnel. Therefore, deep bell holes should be adequately ventilated, and welders or fitters should not be allowed to work alone.

From the properties of CO_2 previously listed, it can be seen that if a quantity of dry ice were confined in a pipeline, a positive pressure in the line would be created as the dry ice sublimed to vapor, and the amount of this pressure would depend upon the volume of pipeline involved, the amount of dry ice used and the ambient temperature. Therefore, where short lengths of line are involved, or where liquid traps at sags and overbends create the effect of a short line, it might be necessary to vent the CO_2 vapor pressure to atmosphere until welding is complete. It is also conceivable that if a large quantity of dry ice were used in a short length of line and and confined between valves or blinds as in some manifold piping, its sublimation to vapor after welding had been completed might result in overpressuring of light weight fittings unless properly vented.

Field trials . . . Our only field use of dry ice has been on an 8-in. crude-oil line. The first trial was for the purpose of installing a gate valve near the downstream end of a recently replaced section of line where it was feared that the conventional mud plug would start wax plugging in the adjacent old and badly waxed section.

A 5-ft. piece of the line was first removed with mechanical cutters, wax scraped out and the inside of the pipe swabbed clean for a distance of about 5 ft. from each of the cut ends. A 7/16-in. hole was drilled with an air drill through the top of the pipe at locations 4 ft. from each end and 10 ft. from each end for sampling purposes. These holes were kept plugged with wooden leak plugs when not in use. Dry ice was then pulverized and 50 lb. packed into each end of the line, the end of the CO_2 being about 18 in. from the ends of the pipe.

In order to determine the flammability of the vapors behind the dry ice, it was thought that a good secondary check, in addition to the combustible gas indicator, might be an Orsat analysis for per cent CO_2. Accordingly, Orsat tests were taken through the hole drilled 10 ft. from one end of the cut line, giving approximately 80 per cent CO_2 10 minutes after placing the dry ice, 84 per cent CO_2 at 15 minutes after, and 99 per cent CO_2 at 20 minutes after.

Corresponding combustible gas indicator readings taken 10 ft. from the weld area with a J-W indicator, ran mostly from zero to 0.1, but some ran as high as 0.45 when taken near the oil film on the upper pipe wall. All tests 4 ft. from the welds were 0.1 or less. The variation in readings at the 10-ft. sample holes might indicate some stratification of vapors. It was felt that the higher readings near the upper pipe wall were partly due to the admission of air through the test holes when inserting the sampling hose. The indicator was used at short intervals during the course of welding at the holes 10 ft. from the welds to assure that the vapors behind the dry ice

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did not reach the explosive range. The CO_2 had been in the line for 4 hours when the tie-in welds were completed. All indicator readings 10 ft. from the welds at this time were below 0.1, so test holes were welded without the use of patches.

The second field use was made during the installation of new pipe across a street. Ends of the existing pipe were cleaned of wax, packed off with dry ice and test holes drilled in the same manner as for the first trial. Tests were made only with the combustible gas indicator before and during trimming and welding with the same results as from the first trial. Some crude oil collected behind one side of the dry ice to a depth of approximately 2 in. before welding was completed, but the CO_2 was not displaced. The dry ice used during this second trial was dissipated after welding by heating the outside of the line opposite it with a butane burner at one location and a large tipped acetylene torch at the other. The acetylene torch tip was moved constantly to avoid overheating the pipe wall.

Both field trials were made while raining, at an ambient air temperature of 52°F.

Conclusions

Dry ice can be used successfully for oil-line repairs. However, the field trials described were made under conditions favorable to its use, and further experience is needed before any general conclusions can be reached or procedures for its use set forth.

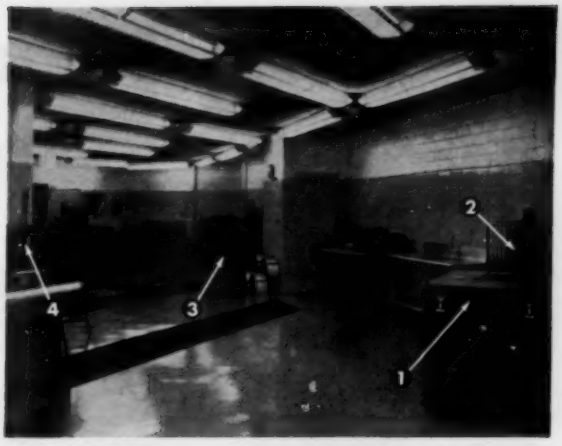
By virtue of its physical properties, dry ice does not form a true weld plug because it cannot be kept from constantly diminishing in size. It rather acts only as a fluid dam and a vapor diluent in a pipeline. Therefore, it is not recommended for use in a line where there is likelihood of accumulation of petroleum fluid or expansion of vapors.

It is anticipated that dry ice will not replace conventional methods of plugging lines, but rather will be considered an additional useful tool for the pipeliner to use with discretion when its advantages for the individual case outweigh those of other methods.

References

1. Handbook of Chemistry & Physics, 1949, Podbielniak, W. J.; California Natural Gasoline Association, Sept. 1928, Hunt, F. B.; Temperature-Entropy Diagram for Carbon Dioxide from Plank & Kuprianoff, Chicago, Ill., January 1930.
2. Coward and Jones, "Limits of Flammability of Gases and Vapors," U. S. Bureau of Mines Bulletin 503.
3. Liquid Carbonic Corp., "Technical Bulletin No. 34," Chicago 23, Illinois, January 1955.

1. Insulation Test Equipment
2. Dielectric Test Equipment



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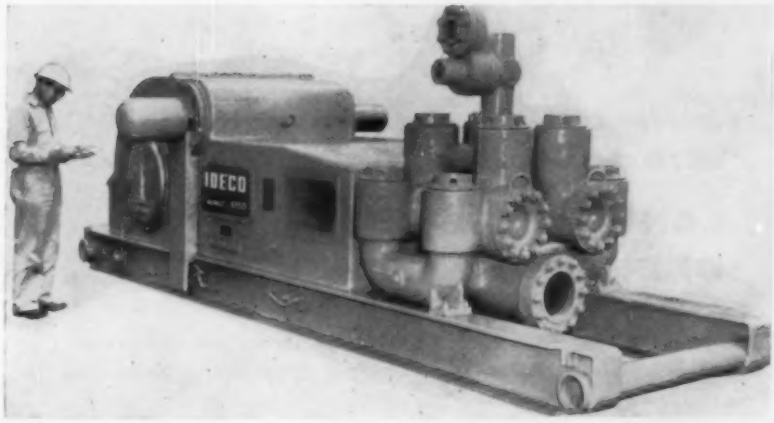

New Mud Pump Designed for Deep Drilling

Designed to meet the requirements of deep drilling, this new Ideco 1,250-hp. Mud-Master duplex slush pump has a weight of only 43.8 lb. per horsepower. Weighing a total of 54,788 lb. with expendables, the pump is of all-steel fabriform construction with integral skids.

Its features include: (1) a one-piece normalized-steel fluid end with thick walls and streamlined passages for efficient operation under sustained high pressures, (2) two-piece threaded-valve-pot covers providing quick removability, and allowing the inner cover to compress the packing without twisting it, (3) 20-in. reversible herringbone gears, (4) preloaded double-row tapered main and connecting-rod bearings, (5) two separate power-end lubrication pumps located outside the main frame for easy access, (6) a counterbalanced crankshaft assembly, for low impact loading and smooth pump operation, particularly important on barge and offshore installations, (7) a screw type of stuffing-box cartridge threaded into a separate stuffing-box housing, and (8) crankshaft and connecting-rod bearings having a built-in hydraulic removal system.

The entire crankshaft assembly can be removed from the pump without disturbing the pinion shaft. Each fluid end is hydrostatically tested to 9,000 psi. on the discharge side and 4,500 psi. on the suction side, before final assembly.

With 8-in. liners and at 65 strokes per minute, the pump will deliver 940 g.p.m. at 1,940 psi. With 6-in. liners, it will deliver 495 g.p.m. at 3,680 psi. The stroke is 18 in. **Write or call: Ideco, Inc., P. O. Box 1331, Dallas, Tex., for details on 1,250 hp. Mud-Master pump.**

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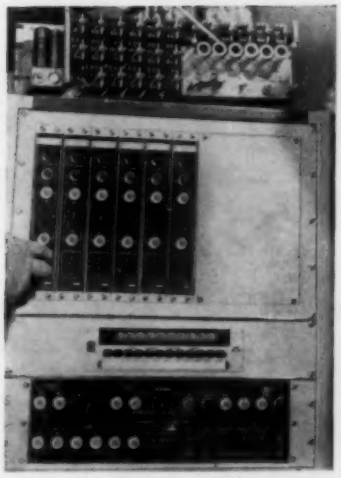

Supervisory Control System Performs Many Functions

Here's a new supervisory control system that allows more than 1,000 different codes to be transmitted over a single two-way channel. The new system will control and continuously supervise hundreds of functions at remote locations, according to company officials. And it is capable of alternate use with a teletype.

The system is particularly suited for control of pipelines, power stations, and similar applications. Operators at one or more locations can control equipment at distant points and get positive identification that each job is done. The ERX (electronic remote switching) unit operates on any com-

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A principal feature of the system is that whenever a change of a remote function occurs, a code signal is transmitted to the control center where it sounds an alarm and lights a disagree lamp. **Write or call: Hupp Electronics Co., Div. of Hupp Corp., 743 Circle Avenue, Forest Park, Ill., for details on ERX supervisory control system.**

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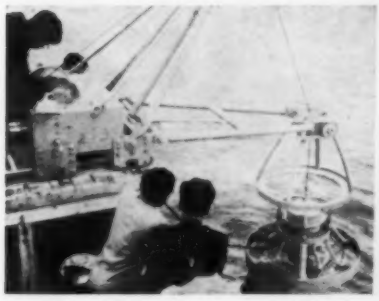

Marine Gravity Meter Is Submersible to 800 Ft.

This new Model UW-2R marine gravity meter, a remote-reading self-leveling underwater instrument, is submersible to 800 ft. of water. And its depth indication is accurate to 0.5 per cent.

The instrument will obtain data accurate within 0.01 milligal, according to the maker. The operator at the console easily controls all functions, with all functions metered. Resetting the meter to within reading range is simple and positive. **Write or call: North American Geophysical Co., 3601 West Alabama, Houston, Tex., for details on Model UW-2R marine gravity meter.**

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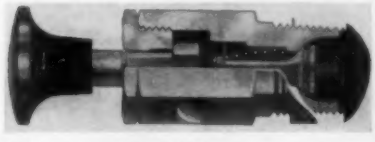

New Tank Valve Does Two Jobs

This new Model P-646 valve for tank or fluid systems can serve the dual functions of: (1) breaking vacuum automatically in draining, and (2) bleeding air displaced in filling, the maker reports.

Normally the valve seals tight, preventing loss of system pressure. But when the fluid is being withdrawn from the system or temperature drops, the valve opens automatically to break the vacuum and permit free flow. A manual override permits holding the valve open to release entrapped air when the system is being filled.

Using an O-ring for tight shutoff, the valve is easy to maintain, the maker reports. Its floating poppet design provides self-cleaning.

Made of lightweight aluminum, the valve comes in ½ and ¾-in. pipe sizes. **Write or call: Circle Seal Products Co., Inc., 2181 East Foothill Boulevard, Pasadena, Calif., for details on Model P-646 valve.**

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Corrosion-Resistant Pipe Comes in Lengths to 20 Ft. 6 In.

These two corrosion-resistant stainless steels, known as Carpenter Alloys B and C, are now available in full-finished long lengths of tubing and pipe. Mill lengths of up to 20 ft. 6 in. are

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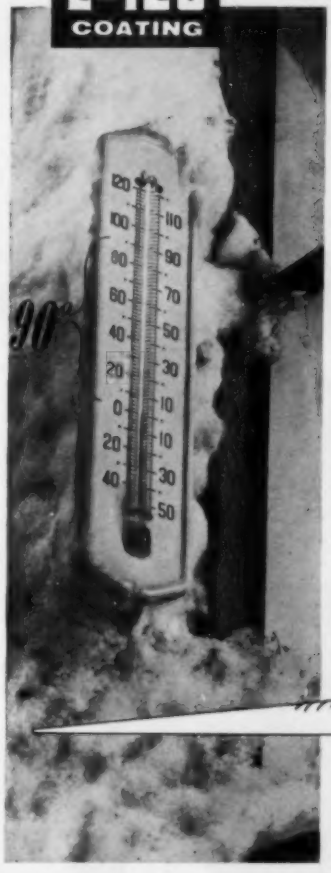

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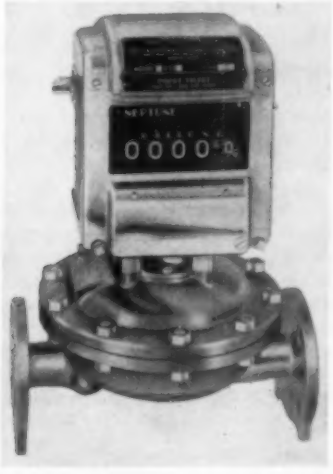

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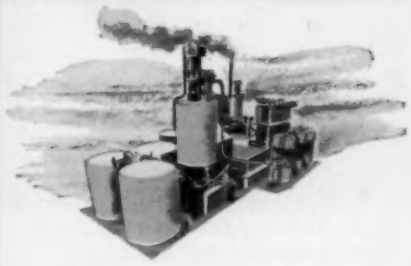

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The register can be calibrated for U. S. gallons, pounds, imperial gallons, liters, and other units. Calibration adjustments are easy to make to meet changing conditions of temperature, specific gravity, etc. **Write or call: Neptune Meter Co., 19 West Fiftieth Street, New York 20, for details on stainless-steel liquid meter.**

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Oil-Well Timer Does Many Jobs

Though this McMurry Type T-NC straight timer is designed primarily to be used for "stop-cocking" production from flowing oil wells, also it is expected to find use as a gas-lift intermitter where the input-system pressure remains fairly stable and the production from the well does not justify the higher cost of a Type A-NC intermitter.

The motor valve in the tool is made to open or close by the clock on fixed time intervals.

Also the unit may be obtained with a Bourdon-tube pressure control for tubing-pressure control. When furnished with the pressure control, the tool is designated as the Type TP-NC. **Write or call: McMurry Oil Tool Specialities, 1020 Houston Avenue, Houston, Tex., for details on Type T-NC Timer.**

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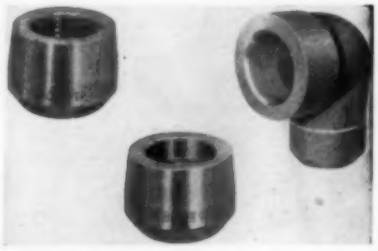


Outlet Tank Connection Is Installed Easily

Here is an easy-to-install branch outlet connection for pipelines, tanks, and pressure vessels. Named Couplet, the fitting is designed to function as a universal outlet connection.

On most tank, vessel, and large pipe-

(Continued on page 147)

PENN ENGINE SAFETY CONTROL acts to prevent costly loss!

Quick, protective action . . . that's what you get with a Penn Safety Control. Overheated cooling water or oil pressure failure can develop in the finest of engines. When this happens, serious damage will occur . . . but not if the engine is protected by a Penn Safety Control.

If water temperature rises beyond the safe point, or if oil pressure falls too low, the Penn Safety Control automatically sounds an alarm, flashes a warning light, or stops engine operation . . . whichever you choose. Then the cause can be investigated and the fault corrected before serious damage occurs.

ACT NOW . . . find out all about this low cost automatic protection for your new or old engines. Ask your Penn jobber today!

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, GAS APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

these *Mines* – these *Mills*

PRODUCE THE WORLD'S FINEST DRILLING MUDS

Magnet Cove, Arkansas
(barite mine)

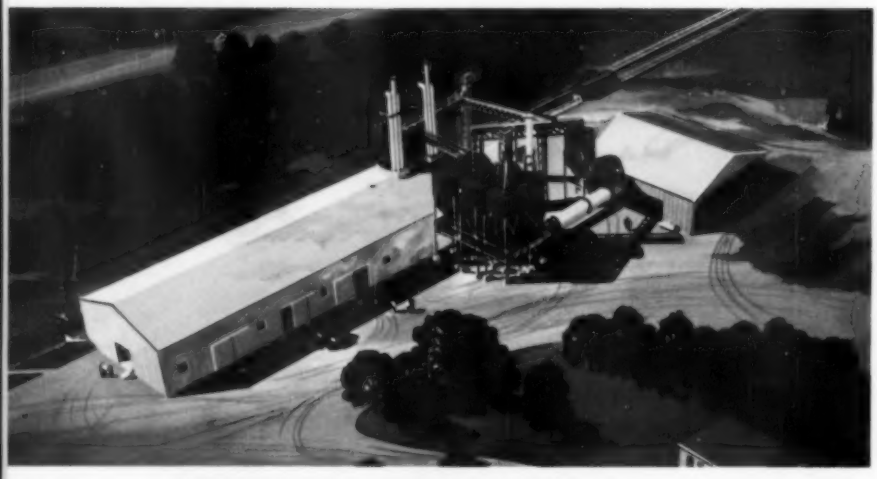
Magcobar

THE INDUSTRY'S LARGEST PRODUCING FACILITIES

Magcobar *brings you an assured supply of drilling mud*

Drilling mud . . . the kind in the Magcobar bag . . . comes from all over the world. And with drilling muds and chemicals playing a bigger role in today's deeper, higher pressure drilling, it is vitally important that the oil industry knows exactly where its supply will come from in the years ahead.

The future supply of high quality drilling muds



Zavalla, Texas
(clay mine and processing plant)

●

Battle Mountain, Nevada
(barite mine and processing plant)

●

Malvern, Arkansas
(barite processing plant)

depends on production capacity and raw material reserves, particularly barite deposits. Magcobar is the world's largest producer of barite.

Magcobar's leadership has been achieved in only one way . . . the investing of millions of dollars for mine and plant construction and a continuing search for and acquisition of raw material reserves.

In addition to the mines and plants shown here, Magcobar has mines in Nova Scotia, Mexico, and Potosi, Missouri.

This world-wide program assures you of the highest quality materials from Magcobar today . . . and in the future!

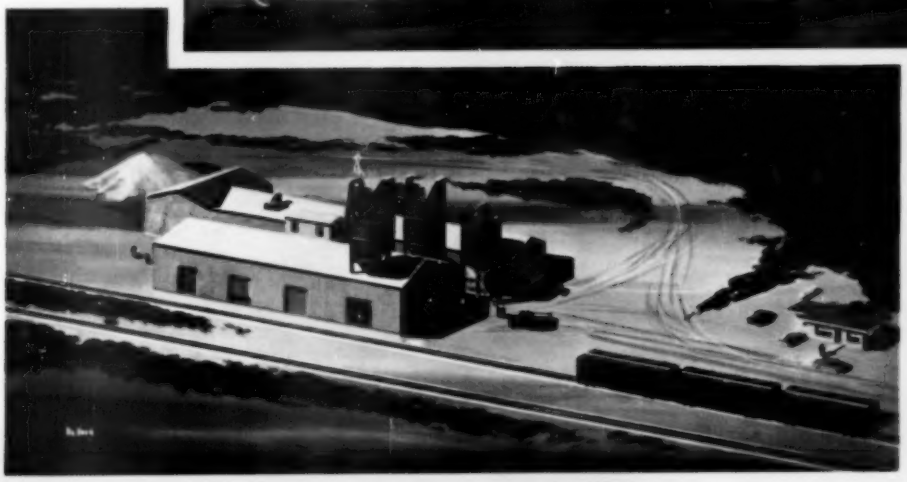
Mykonos, Greece
(barite mine and processing plant)

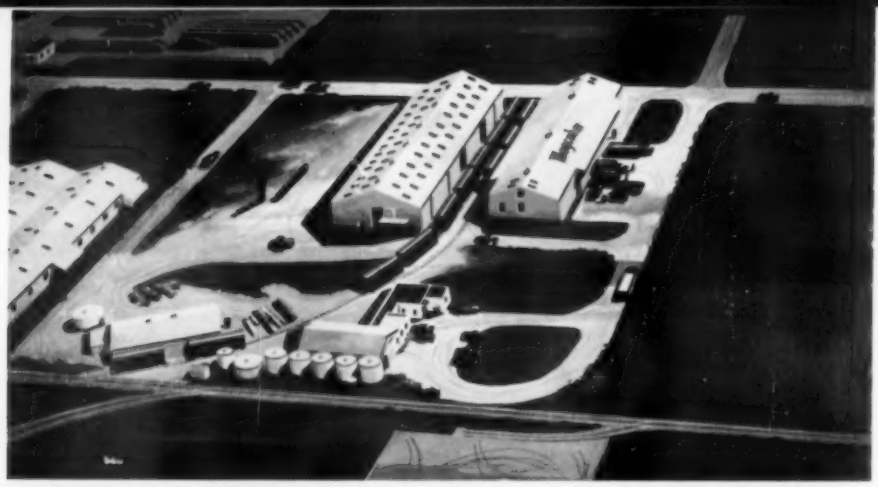
●

Hinson, Florida
(clay mine and processing plant)

●

Brownsville, Texas
(barite processing plant)





Houston, Texas
(processing plant)

●

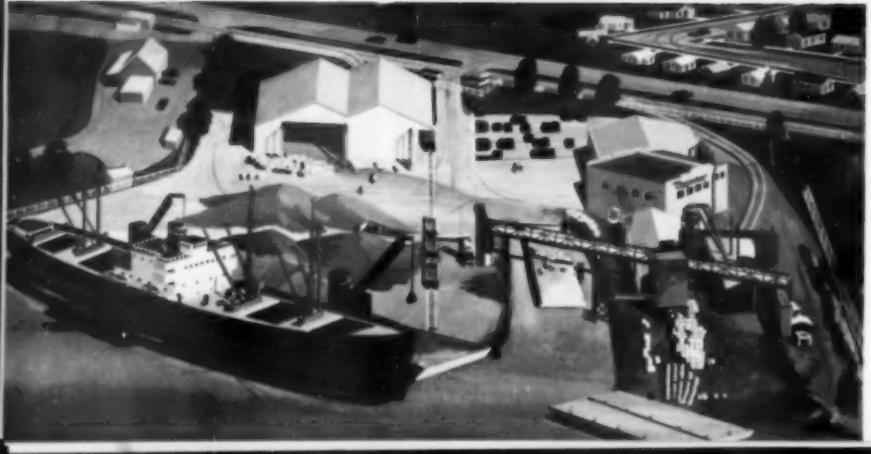
Lake Charles, La.
(barite processing plant)

●

Greybull, Wyoming
(bentonite mine and processing plant)

●

New Orleans, La.
(barite processing plant)



Magcobar

Complete

DRILLING MUD SERVICE

MAGNET COVE BARIUM CORPORATION

HOUSTON, TEXAS

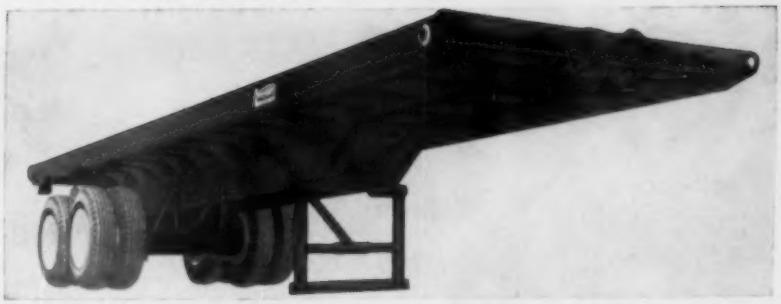
Litho in U.S.

New Equipment

line applications, the couplet can be used without modification. On applications where attachment is to be made to a small-diameter pipe, the couplet is easily modified by contouring the welding end with an acetylene torch to mate with the curvature of the pipe diameter.

The couplet is made with an extra length and heavier wall to permit contouring without detriment to the strength of the fitting, weld or threaded or socket end. This flexibility of application of the couplet is said to eliminate the need for large, expensive field inventories and costly delays in fabrication. These branch-outlet connections are in full production.

The couplet is available in sizes of ¼ through 2 in., with screw-end or socket-welding-end connections. It is also available in 90° elbows. And it can be obtained in a forged-carbon-steel (A.S.T.M. A-105, Grade 2) 3,000-lb. W.O.G. class screw-end type and a Schedule 40-80 socket-welding type. **Write or call: W-S Fittings Div., H. K. Porter Co., Inc., P. O. Box 95, Roselle, N. J., for Bulletin CP-1-57.**



Lightweight Float Carries Heavy Loads

This new 808 Oil-Field Float, a lightweight, heavy-duty trailer, according to company officials, weighs less than conventional trailers, yet is rated for as much as 5 tons more payload.

The favorable weight-strength ratio has been achieved through the use of special steel with a 9-in. outer rail and a frame 18 in. deep.

Weighing 9,600 lb., the trailer is designed for three-point stability in nose loading. It has an oversize rolling tail pipe with self-aligning bushings.

The double pivot is said to keep the load in balance. And the combination bar-spring tandem principle provides flexibility for light loads, with a gradual stiffening-up under heavy loads as the springs deflect against the bar. **Write or call: Spencer-Safford Loadcraft, Inc., Augusta, Kan., for details on 808 trailer.**

●

Metal Coating Protects Pipe from Corrosion

Protection against chipping and peeling plus high resistance to acid and caustic fluids is provided by a new coating called TK-33.

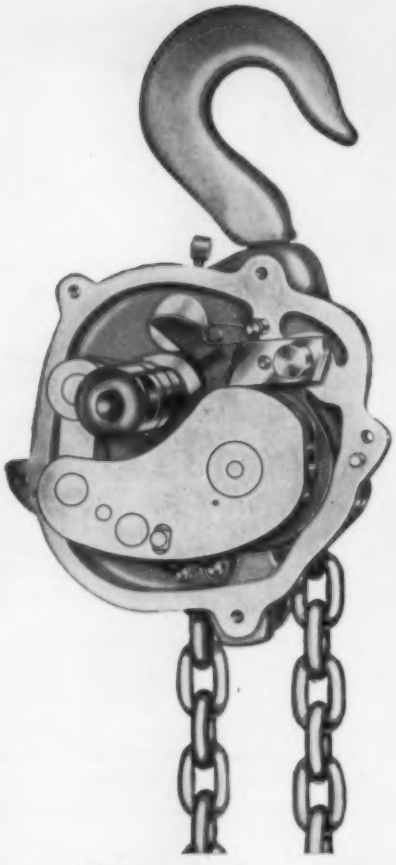
The coating was developed to solve corrosion problems in pipe for gathering lines, salt-water-disposal systems, flow lines, etc. Its formulation contains polyurethane. **Write or call: Tube-Kote, Inc., P. O. Box 20037, Houston, Tex., for details on TK-33 coating.**

INTERNAL CORROSION SURVEY SERVICE

Otis Tubing Caliper Surveys in the hole under pressure... casing surveys... rod wear inspection

OTIS/Branches Throughout the Oil Country

PRESSURE CONTROL - OTIS - SERVICE - EQUIPMENT



New ..... Compound ..... Levers .....

Make Coffing Super Powers the most efficient hoists in their class

Super Power hoists are designed around a new compound leverage principle. The levers, which replace the gears of conventional designs, enable workmen to raise loads with less handle pull than other hoists of the same capacities. Since use of the levers also reduces hoist size and weight, the workmen have 20% less weight to carry to the job.

Available in 1½ and 3 ton capacities in aluminum, and 1½ to 5 tons in malleable iron, Super Powers require little maintenance, since moving parts have sealed-in lubrication. Overload testing, "Safety Valve" handles, and constant load-locking ratchet and pawl assure safe operation. For complete details on these hoists, consult your favorite supply store or write to us for Bulletin L-3.

DUFF-NORTON

Coffing Hoist

DIVISION OF **DUFF-NORTON COMPANY**
818 WALTER STREET DANVILLE, ILLINOIS

Ratchet Jacks, Screw Jacks, Hydraulic Jacks, Special Worm Gear Jacks, Ratchet Hoists, Electric Hoists, Load Binders, Spur Gear Hoists

SAFE!

with SUPER-TOUGH *McDonald* SAFETY BELTS

TYPE R—Derrickmen's Belt—Adjusts from 28" to 48"—weighs 1 lb. 13 oz., 3" body pad. D ring remains in same relative position regardless of size to which belt is adjusted.

TYPE S—Insta-Release Derrickmen's Belt—Adjusts from 28" to 48"—weighs 1 lb. 10 oz., 3" body pad. Insta-Release buckle lets wearer free himself instantly.

Leather parts on both belts silicone treated to maintain flexibility—waterproof, acid resistant. Metal parts are drop forged and Magnaflux tested to detect and discard those with even the most minute flaws.

WRITE FOR BULLETIN & PRICES

B-F-McDonald COMPANY
Manufacturers & Distributors of Industrial Safety Clothing & Equipment

5721 West 96th St., Los Angeles 45
3745 Greenbrier Dr., Houston 6

SHOWCASE . . .

New Literature

Screw-End Venturi Type Valve. This catalog sheet illustrates and gives specifications and prices of Orbit Valve Co.'s new 2 by 1-in. venturi type of production valve with screw ends. It also lists the advantages of forged-steel with stainless-steel trim. **Write or call: Orbit Valve Co., 3000 Sand Springs Road, Tulsa, Okla., for catalog sheet on venturi-type valve.**

●

Sand Pumps, both rod and wire-line types, ranging in size from 2⅛ through 4¾ in., are described in four-page Bulletin 55. The bulletin details the pumps' applications and specifications. **Write or call: Grant Oil Tool Co., 2042 East Vernon Avenue, Los Angeles 58, Calif., for Bulletin 55.**

●

Surface Active Agents for use in most industries for wetting, dispersing, detergency, foaming, and emulsification are the subject of this 52-page booklet. The booklet contains charts giving specifications and typical analyses and a summary of the chemical and physical properties of the surface-active agents. The new booklet also gives technical data on seven types of Aerosol surface agents offered in commercial quantities (including their use in basic formulations), data for testing effectiveness, and information on storage and handling. **Write or call: American Cyanamid Co., Manufacturers Chemicals Department, 30 Rockefeller Plaza, New York 20, N. Y., for a copy of booklet on surface-active agents.**

●

New Fracturing Additive, called Gypban, is described in this new four-page folder. The additive was developed to prevent formation-plugging gyp deposits that cause rapid declines in oil production. It is a complex phosphate sequestering agent that is oil soluble and dissolves only very slowly in water. It is in the form of granular material about the size of sand grains used for fracturing. The folder explains how Gypban is applied and how it prevents precipitates from forming. **Write or call: Dowell Incorporated, P. O. Box 536, Tulsa, Okla., for folder on Gypban.**

●

Heat Exchangers with a working pressure of 75 psi. and a test pressure of 115 psi. for use with internal combustion engines, compressors, hydraulic equipment, torque converters, and turbines are diagramed and described in

R/M Teflon PACKINGS

solve the toughest sealing problems

Hard-to-handle acids, caustics and solvents are no problem with R/M "Teflon" packings. Not only do they outlast conventional packings, but their effective sealing action and low coefficient of friction make the equipment they are used on last longer, too.

R/M's complete line of "Teflon" products includes these mechanical packings, all of them particularly useful in oil refineries:

R/M No. 840SW—High grade asbestos yarn packings impregnated with "Teflon" suspensoid. For use in valves handling solvents.

R/M No. 843—Made by extruding a plastic mix of "Teflon" and other compounds into an open cotton-braided jacket. For use in pumps handling dilute acids and chemicals.

R/M No. 847—A braided and cross-locked "Teflon" filament packing, dry except for impregnation with "Teflon" suspensoid. For valves handling solvents, strong acids, and corrosive fluids.

R/M No. 848—Like No. 847, except that the dry packing is lubricated with a high-temperature, chemical-resistant material. For use on pumps handling concentrated acids, slurries and solvents.

R/M engineers have amassed valuable experience in blending "Teflon" with asbestos and many other hard-to-handle materials. They will be glad to work with you on any of your special packing problems. Write today for booklet on R/M "Teflon" packings.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS—including Vee-Flex, Vee-Square, Universal Plastic, and "versi-pak"*; GASKET MATERIALS, "TEFLON"* PRODUCTS. SEE YOUR R/M DISTRIBUTOR

*A Du Pont trademark

R/M PACKINGS

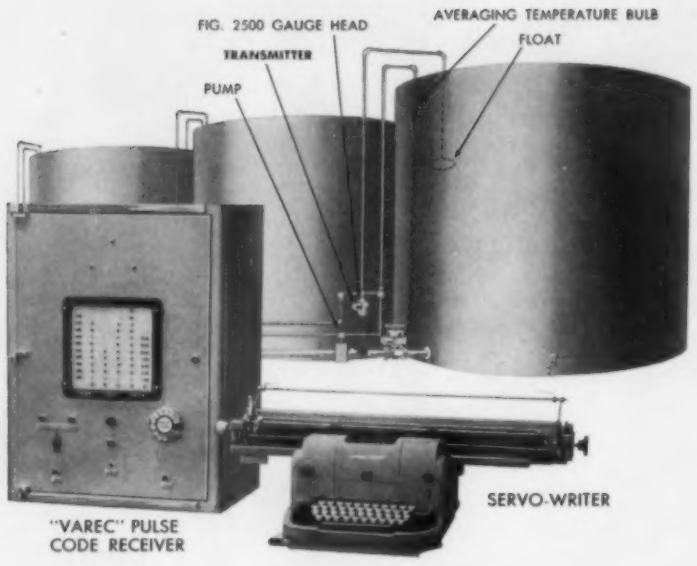
RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, PASSAIC, N.J.

MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; Neenah, Wis.; No. Charleston, S.C.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers



If You're "Automating"
Compare "Varec" PULSE CODE

"Varec" PULSE CODE Telemetering can give you an accurate transmission system over unlimited distance for remote gauging of liquid level, temperature reading, and remote control of valves and pumps. A printed record can be provided by an electric typewriter.

Here's why . . .

1. "Varec" PULSE CODE is a true digital system. It avoids the variations of reading caused by interpolation of analog systems.

2. "Varec" PULSE CODE and the pulse count systems are the only true digital systems. In the PULSE CODE system, pulses are arranged to code groups of numbers. Each element of the code or each pulse has two possible conditions, or short and long (also called dot and dash).

The pulse count system relies on transmitting, receiving and counting a number of pulses to represent intelligence. For example, to telemeter the number 10, ten pulses are transmitted and then "counted" by the receiver. The pulse count may send 10 pulses for 10, but due to variations in the power supply, receive and indicate only nine. Whereas, if "Varec" PULSE CODE lost a pulse in transmission for any reason, the signal would make no sense to the receiver. So it refuses to provide any indication, which is better than indicating an error. Same action would occur if an extra pulse were received.

"Varec" PULSE CODE provides immunity from errors caused by changes in signal during transmission.

3. "Varec" PULSE CODE transmits a message in one-fifth of the time required by a pulse count system.

4. To prevent errors of as much as one foot during a gauging cycle, pulse count transmitter must be locked up during gauging cycle to prevent a change in reading, thus the possibility of permanently locking the transmitter is present. No such gadgets are needed by "Varec" PULSE CODE because of the unique characteristics of the code. A signal can be transmitted while the transmitter is changing without errors being produced.

5. "Varec" PULSE CODE Telemetering System is based on good operational theory

If you are planning a remote gauging and control system, you'll want the whole story. Send for "A Comparison of Current Telemetering Systems". It's free!

THE VAPOR RECOVERY SYSTEMS COMPANY

"Varec"

2820 North Alameda Street
P.O. Drawer 231
Compton, California

CABLE ADDRESS:
VAREC COMPTON CALIFORNIA (U.S.A.) All Codes V61-21

new Bulletin 170 (four pages). Tables give stock sizes, dimensions, and weights. Dimensional diagrams illustrate the sizes of single, two, and four-pass units. **Write or call: Whitlock Mfg. Co., 77 South Street, Hartford 10, Conn., for Bulletin 170.**

●

Differential Pressure Sensing Unit used to actuate flow, differential pressure, or liquid-level indicators, recorders, transmitters, controllers, integrators, and computers is the subject of new eight-page Bulletin 224-1. The sensing unit is available in housings rated from 500 to 3,000 psi. and differential-pressure ranges from 0 to 75 in. water column to 0 to 400 psi. Cutaway photographs show interior construction and schematic diagrams give dimensions and details for both pipe and wall mounting. **Write or call: Barton Instrument Corp., Monterey Park, Calif., for Bulletin 224-1.**

●

Pipe-Bending Machine made in three models for bending pipe with diameters of 6 through 36 in. is described in this new four-page bulletin. The bulletin furnishes complete specifications and over-all dimensions for all three models. The CV series vertical pipe-bending machine bends pipe with diameters of 22 through 36 in., the MV series bends pipe with diameters of 16 through 30 in., and the WV series bends pipe with diameters of 6 through 20 in. **Write or call: M. J. Crose Mfg. Co., Inc., Cinch Div., 7020 Long Drive, Houston, Tex., for bulletin on pipe-bending machines.**

●

Fluorescence-Analysis Cabinet designed to speed up core inspection is described and illustrated in this data sheet. The device, according to the data sheet, is portable and easy to use in the field or laboratory. Its light-tight compartment permits rigorous examination and analysis of cuttings and cores in bright daylight. The data sheet gives complete specifications and prices. **Write or call: W. H. Curtin & Co., 1800 Sidney, Houston 1, Tex., for data sheet on Mineralab.**

●

Express Rollers for moving heavy machinery or equipment easily are detailed in this new four-page folder. Made in five sizes, the rollers offer capacities ranging from 500 lb. to 150 tons. The rollers are equipped with roller bearings to reduce friction and eliminate the need for winches, particularly when lighter weight machines are moved.

NEW LEE C. MOORE MAST DESIGN

. . . . . *especially suited for offshore drilling*

To meet the special requirements of offshore drilling, Lee C. Moore engineers have designed a new BRACED "A" FRAME cantilever type mast.

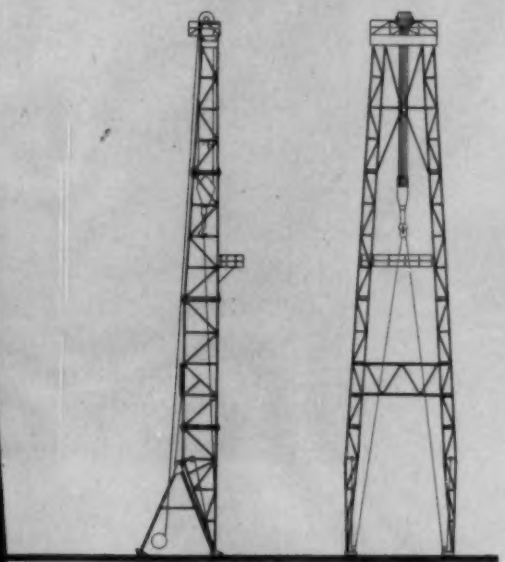
This mast is available with narrow top for single line multiple well locations by tilting, or with wide top so that crown can be shifted laterally for multi-line locations, or for tolerance of 4 ft. square area for positioning crown over well site. Mast can also be furnished to tilt out by means of luffing lines for use as a boom.

This mast has a gross nominal capacity of 1,000,000 lbs. with a 30 ft. leg spread at the base and can be lowered to a horizontal position for more stable towing of the barge or for added protection during hurricane conditions.

LEE C. Moore CORPORATION

TULSA : HOUSTON : NEW ORLEANS : CENTRALIA : ODESSA
MIDLAND : DALLAS : GREAT BEND : CASPER : PITTSBURGH

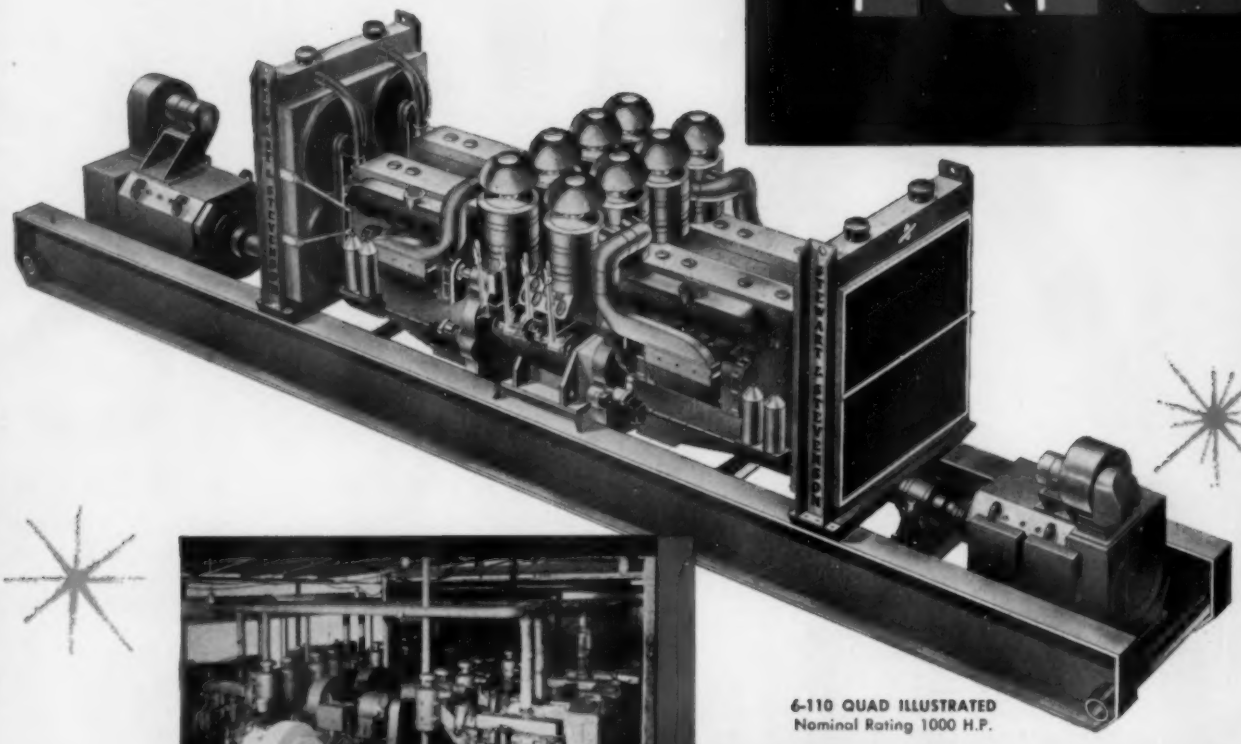
EXPORT OFFICE: ROOM 624, INTERNATIONAL BLDG., 630 5TH AVE., NEW YORK 20, NEW YORK
FOREIGN LICENSED MFR.: OIL WELL ENGINEERING CO., LTD., CHEADLE HEATH, STOCKPORT, ENGLAND



driller's side *front side of mast with 10' top*

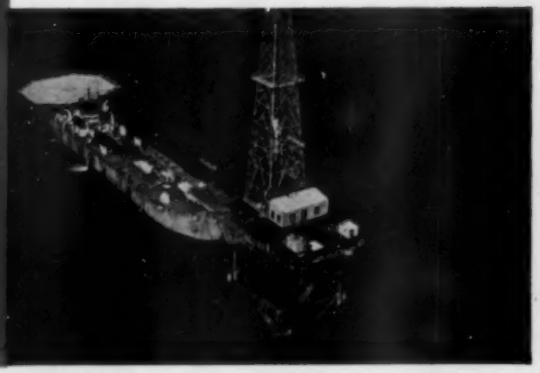
Proved in the past..

RIG



6-110 QUAD ILLUSTRATED
Nominal Rating 1000 H.P.

RIGELECTRIC is now available with General Motors Detroit Diesel Engines or the Natural Gas Engine of your choice . . . Le Roi, Climax, Waukesha or Allis-Chalmers (Buda).



RIGELECTRIC Units have been in service for more than two years. Available in 3 models with more than 16 different power arrangements to meet every land or off-shore application, from 3000 feet to 25,000 feet.

THE WORLD'S LARGEST DISTRIBUTORS OF DIESEL ENGINES

. Improved for the future

ELECTRIC*

by STEWART & STEVENSON

New and improved Stewart & Stevenson RIGELECTRIC engine electric drives for oil well drilling rigs are the result of many years of experience gained in the successful application of Diesel and gas engines for both straight mechanical and electric drive in the oil field.

The new and improved RIGELECTRIC arrangements incorporate a simplicity of design associated with the original RIGELECTRIC principles plus a far broader range of improvements and flexibility which provide a variety of "alternates" in the event of an emergency. All of this is accomplished with a minimum use of contactors in the "functional" operation of the RIGELECTRIC system.

Although RIGELECTRIC arrangements are offered with multiple General Motors Diesel engine prime movers as standard equipment, RIGELECTRIC can also be furnished with the gas engine of your choice, without sacrificing the full responsibility and guarantee of Stewart & Stevenson Services, Inc.

Unlike other engine electric systems for drilling rig drive, you do not have to suit your rig to some manufacturers' standard design. RIGELECTRIC is offered in a complete range of sizes and models to suit **your** specific requirements. Whether you operate on land or offshore, use Diesel fuel or natural gas, prefer trailer mounting, or skid mounting, 3000 foot holes or 25,000 feet, there is a RIGELECTRIC oil field arrangement available to suit your job.

1. **SIMPLE CONTROLS** — With RIGELECTRIC, each electric motor is operated from an individual generator so that there is never more than one motor being driven from a single generator. This arrangement permits the use of a low voltage rheostat control for each generator, which in turn governs the speed of each motor. RIGELECTRIC controls contain fewer parts, are ruggedly built for oil field service, and consequently are easier to service.

2. **MULTIPLE ENGINE DEPENDABILITY** — On the Model 24-1000 RIGELECTRIC power packages, four 250 HP engines with a combined capacity of 1000 HP are furnished. With this arrangement, if one engine should be out of service, then the other three combine to give ¾ of the full power into the generators.

3. **CONSERVATIVELY RATED ENGINES** — The engines offered with RIGELECTRIC are designed and proven in oil field service and produce their HP with lower BMEP, low piston speeds, and have adequate reserve for over-loading on intermittent service. For example, the Model 24-1000 RIGELECTRIC power package develops 920 continuous HP with a BMEP of only 76.5 psi. This is far lower than any other competitive power package offered for Diesel electric drive. At a BMEP of 85 psi (which is still far lower than competitive Diesel electric power packages) the Model 24-1000 RIGELECTRIC unit develops over 1000 BHP. These conservative HP ratings insure longer life with trouble-free service.

4. **SHUNT WOUND MOTORS** — RIGELECTRIC systems employ the use of shunt wound motors which operate in parallel with each connected generator. Shunt motors have as an inherent characteristic a definite design top speed. No torque limit or overspeed controls are necessary with RIGELECTRIC shunt motors, consequently simplifying controls and adding to the safety of the entire system.

5. **LOWER VOLTAGE** — RIGELECTRIC systems operate at only approximately one half of the line voltage as some other Diesel electric systems. This results in greater safety as well as less maintenance especially on offshore installation.

6. **PARTS AND SERVICE** — RIGELECTRIC units use only standard electrical components which are available from Stewart & Stevenson stocks. The normal inventory of back up parts consists of every single component, either electrical or mechanical, that goes into a RIGELECTRIC arrangement.

7. **ONE RESPONSIBILITY** — RIGELECTRIC units are designed, built, tested and backed by Stewart & Stevenson Services, Inc., the world's largest distributor of Diesel engines. The responsibility of Stewart & Stevenson Services, Inc., and the attitude of the management of Stewart & Stevenson toward "after sales service" and customer satisfaction is thoroughly tested, tried and proven in oil field circles everywhere. Regardless of what type engine you choose to power your RIGELECTRIC system, Stewart & Stevenson guarantees the successful performance of the complete equipment on your job.

STEWART & STEVENSON SERVICES, INC.

Main Office and Plant: 4516 Harrisburg Blvd., Houston 11, Texas. Phone CApitol 5-5341

Branches: Corpus Christi, Dallas, Lubbock, San Juan, Odessa

Representatives: San Antonio, Longview, Brownsville, Tyler, Pecos

Export Office: Room 1405, 74 Trinity Place, New York, N. Y.

STEWART & STEVENSON

* "RIGELECTRIC" REGISTERED TRADE MARK FOR STEWART & STEVENSON DC DRILLING RIG POWER

They're Interchangeable
They're Simple
They're Quick

Put Economy and Flexibility in your Pipelines

STANDARD and LIGHTWEIGHT
ALUMIRON COUPLINGS
(Made in Aluminum or Malleable Iron)
For Grooved End Pipe

● Think back—remember the effort required to make and complete pipeline joints? Now you can do it an easier way with these two-bolt malleable iron Couplings. Pipeline progress dictated the design of Alumiron Couplings making them the simple, quick, positive, low cost way to join grooved-end steel, aluminum, cast and wrought iron and spiral pipe.

● Alumiron speedily joins grooved-end pipe by the mere tightening of two bolts which run through the coupling halves. The Buna N or oil resistant Neoprene gasket inside the coupling halves firmly and evenly grips the pipe ends making a leak-proof seal which increases as pipeline pressure mounts. This flexible Coupling permits the line to "come and go" with rough and uneven terrain. Component parts are interchangeable with other grooved-end couplings.

● Standard Series to 1,000 PSI working pressure in sizes 1" through 8". Lightweight Series to 500 PSI working pressure in sizes 2", 2½", 3", 4".

Send for literature and prices. Distributor territories open.

CHARLES E. MANNING CO.
4700 CLAIRTON BLVD.
PITTSBURGH 36, PA.

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Let's talk over your
PRODUCTION FINANCING

Financing oil production takes a specialist— a *financial* petroleum engineer who knows the problems, speaks the language of the producer. Texas National's financial engineers have many years of experience in financing oil production which can be put to work for you. Come in and let's talk it over.

TEXAS National BANK
OF HOUSTON

The folder furnishes specifications for both the rollers and for turning attachments. **Write or call: Express Roller Div., Industrial East Co., P. O. Box 561, Clifton, N. J. for express-rollers folder.**

●

Plated Metal Screens designed to serve purposes lying between those now covered by perforated metal and woven-wire screen are described and illustrated in this new four-page leaflet. The screens are built up as a one-piece solid-metal product wholly by electrodeposition. No woven or other foundation structure is included in the process. Called Lektromesh, the screens are porduced in counts (equivalent of mesh) ranking from 25 to 400 in thicknesses from 0.0005 to 0.012 in. and in nickel, copper, and copper-nickel. **Write or call: C. O. Jelliff Mfg. Corp., Southport, Conn., for Lektromesh leaflet.**

●

Flame Cutter described in new four-page Bulletin FC8 can be used for cutting both new and used welding fittings. The flame cutter is a self-contained unit. It merely requires connection to the user's source of gas and power. The brochure shows how the machine can be used to reclaim such fittings as return bends, tees, ells, and weld-neck flanges with diameters ranging from 2 in. up to 20 in. and larger. **Write or call: Vernon Tool Co., Ltd., 1101 Meridian Avenue, Alhambra, Calif., for Bulletin FC-8.**

●

Positive-Volume Type of Liquid-Metering Vessel designed for field use to accurately meter oil and water from a separator or treater is described in this new data sheet. The data sheet furnishes specifications, lists standard equipment, and explains how the metering vessel operates. The vessel is available for working pressures to 1,200 psi. **Write or call: Delta Tank Mfg. Co., Inc., P. O. Box 1469, Baton Rouge, La., for data sheet on PV liquid-metering vessel.**

●

How a Bar Lugger can speed in-plant handling of square, round, or rectangular bar stock is explained in this new two-page leaflet. Providing a 2,000-lb. capacity, the device hooks on to the plant overhead conveyor. It can be used for bin storage or withdrawal, in either pigeon-hole or open type of storage racks, and it allows one man to handle as much material as that normally handled by two, according to the leaflet. **Write or call: Industrial East Co., P. O. Box 561, Clifton, N. J., for Bar Lugger leaflet.**

WORTHINGTON WATERFLOOD PUMP CONTEST

WIN YOUR VACATION IN BERMUDA

Ten big prizes – closest to industry survey wins

First Prize—Bermuda vacation for two. Seven activity-filled days in the "Isles of Summer." You enjoy six nights at the world-famous Castle Harbor Hotel. Includes transfers, a scenic motor tour, an exciting inter-island yacht cruise, all meals, round trip air tourist transportation from New York City, and the Bermuda Tourist Tax. Transportation in U. S. to and from New York City.

Second Prize—Delta Radial Saw Workshop. 9" radial saw, guard, anti-kick back attachment, grain fir table, ¾ hp motor included.

Third Prize—Sylvania High Fidelity Console Phonograph.

Fourth Prize—Winchester No. 50 Semi-Automatic Shotgun.

Fifth Prize—Polaroid Highlander Camera.

Sixth Prize—Skil 8¼" Saw.

Seventh Prize—Camping Tent.

Eighth Prize—24" Two-Suiter Cowan Luggage.

Ninth Prize—Skil Jig Saw.

Tenth Prize—Philco Clock Radio.

RETURN CARD →

OFFICIAL RULES

1. Turn the page, study and rate the six features of Worthington water-flood pumps using the post-card entry blank on this page.
2. Detach card and mail.
3. To be eligible, entries must be postmarked no later than August 31, 1957 and be received no later than September 10, 1957. In the event of ties, prizes will be awarded to entries bearing earliest postmarks.
4. Contest is open to all residents of the U.S. and its territories, except employees of the Worthington Corporation, its advertising agencies, or distributors, and their families. Contest is subject to federal, state, and local regulations.
5. Entries will be judged on the basis of closest rating to Worthington 1957 power pump survey. Judges' decisions will be final.

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 11, Harrison, N. J.

WORTHINGTON WATERFLOOD PUMP CONTEST

WORTHINGTON CORPORATION

HARRISON, NEW JERSEY

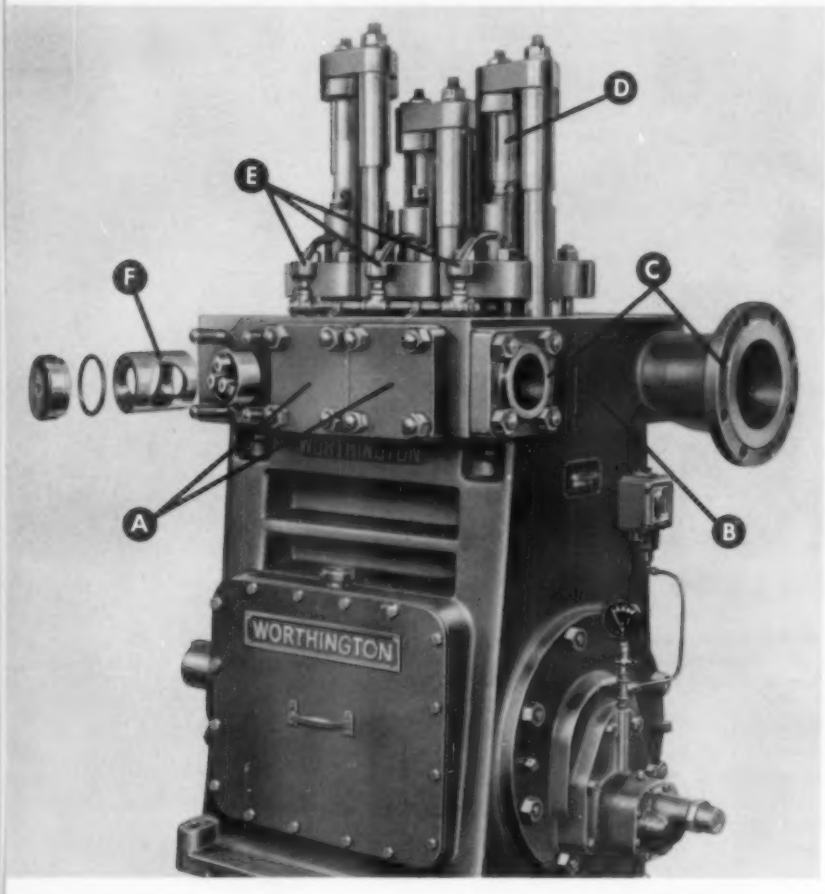
WIN YOUR VACATION IN BERMUDA

HOW WOULD YOU RATE THIS PUMP?

Here's all you do to get in line for one of the big prizes described on the preceding page.

Study the six outstanding features of Worthington waterflood pumps. Then decide how you would rate each one. Is it of limited importance, moderately important, or extremely important? You'll see on the return card below that each feature must be job-rated on a scale from one to ten.

Your answers will be compared with the results of a survey already completed among men who use waterflood pumps and know them intimately. To the ten entries closest to the majority opinion go the ten big prizes.



RATE THESE FEATURES

For each feature mark an X in the box corresponding to your rating of its importance.

A. Individual Bolted Covers for each suction and discharge valve make it unnecessary to disturb pipe connections or remove heavy manifolds to service valves.

B. One-piece Forged Liquid Cylinders containing suction and discharge manifolds for increased strength and corrosion resistance.

C. Flanged and Bolted Liquid End Connections prevent possibility of thread corrosion.

D. Interchangeable Stuffing Box Barrels permit different plunger diameters as pressure conditions change, without buying a new liquid cylinder.

E. Stuffing Box Drain Piping collects packing leakage *before* it stains and corrodes external pump surfaces.

F. Ring Type Double-Ported suction and discharge valves give greater valve area, yet are light enough for operation at modern [redacted] speeds without pounding seats.

Hurry, hurry, hurry! Contest closes August 31, 1957. For complete Waterflood Pump literature, write Worthington Corporation, A&SP Dept., Harrison, New Jersey.

WORTHINGTON

P.7.1.

Here's how I rate the six waterflood pump features:

Of Limited Importance • Of Moderate Importance • Of Extreme Importance

	1	2	3	4	5	6	7	8	9	10
Feature A										
Feature B										
Feature C										
Feature D										
Feature E										
Feature F										

Name_____

Address_____ Company Affiliation_____

City & State_____

P.7.1.

EQUIPMENT MEN . . . in the News

Continental-Emsco Co. Names Two to D+B Posts

Robert M. Erskine has been appointed manager of Continental-Emsco Co.'s D+B sales, and G. H. Lewis has been

R. M. ERSKINE

G. H. LEWIS

named to the newly created post of D+B specialist at large.

Erskine, who will headquarter in Dallas, will direct the sales of D+B subsurface equipment. Lewis will work out of Continental-Emsco's Dallas home office with the company's D+B specialists on both sucker rods and subsurface pumps.

Erskine joined the company in 1953 and was formerly a sales engineer for the D+B division.

Continental-Emsco's D+B manufacturing plant is in Garland, Tex.

Bethlehem Supply Moves Division Office to Calgary

Bethlehem Supply Co. of Canada, Ltd., has moved its division office from Edmonton, Alta, to Calgary. The division office, and now headquarters for Bethlehem Supply Co. of Canada, Ltd., is under the direction of R. B. Dearing, who recently was transferred from Edmonton in the same capacity.

The Edmonton store and warehouse is now under the supervision of R. D. Christopherson.

Weatherford Announces Assignments, Promotions

James M. Smith has been named eastern division manager for Weatherford Oil Tool Co. of Houston, according to Jess E. Hall, Jr., president. Smith will be located in the Lafayette, La., division headquarters.

Earl Max Bradshaw has been employed as a sales and service engineer in the Lafayette area. Miss Nadine Wells has been assigned to head the new western division headquarters in Abilene, Tex. William R. Louderback has been promoted to manager of the advertising, public relations and training department.

Previously, Smith was district manager for Weatherford in Odessa. He joined the company in 1951 and since then has been assistant and district manager in Oklahoma and West Texas. Bradshaw was formerly with Halliburton Oil Well Cementing Co. and Phillips Petroleum Co.

Miss Wells came to Weatherford in 1956. Louderback was formerly employed by Permian Mud Service as assistant district manager in West Texas. He joined Weatherford in 1956.

Cardwell Appoints Lackey Domestic Sales Manager

The appointment of Clyde M. Lackey as domestic sales manager has been announced by J. T. Tucker, general manager of sales, Cardwell Manufacturing Co., Wichita, Kans. Lackey was formerly district manager for Cardwell in the Illinois basin with offices in Mount Vernon, Ill. He will headquarter at the company's Wichita offices.

C. M. LACKEY

Prior to joining Cardwell, Lackey was with Buda Engine Sales & Service as district manager for the Rocky Mountain territory and Kansas.

Oilwell Moves to New Location at Victoria, Tex.

United States Steel Corp.'s Oil Well Supply Division, which first opened a branch store in Victoria, Tex., in 1949, is now in its new location in this Gulf Coast city, according to M. F. Jones, Gulf Coast area manager of the division.

The new store is 100 ft. by 40 ft. with a warehouse section of 40 ft. by 80 ft. and office and display area of 20 ft. by 40 ft. Victor H. Blott is manager of the store.

Tube-Kote Plans Expansion Of Industrial Division

An expansion program through which Tube-Kote, Inc., Houston, will add to the productivity and variety of its industrial division has been announced by Chester Posey, vice president and general manager.

The most immediate project will be the construction of a 40 by 80-ft. structure which will house a 16 by 25-ft. oven for tank-coating work. Tube-Kote has a laboratory for evaluating various coatings as well as conducting tests to determine the suitability of different types of coatings for correct customer recommendations.

The other unit operating at the company's plant is the tubing division where work is centered around internal and external coating of oil-field tubular goods to prevent corrosion.

Robert Riha is manager of the industrial division.

BS&B Creates District, Combines Two Others

Black, Sivalls & Bryson, Inc. has created a new sales district with headquarters at Borger, Tex., according to

T. E. POOL

ED BYERS

Floyd C. Myers, manager of oil-field sales and service. T. E. (Ed) Pool, manager of BS&B's Oklahoma City oil-field sales district for the past 3 years, has been appointed manager of the new district.

In addition, BS&B has also opened a new branch at Liberal, Kans., and has increased warehousing facilities at Borger. With the creation of the new Borger district, the former Oklahoma City and Tulsa districts have been consolidated with the district office established at Tulsa. Ed Byers, who has been Tulsa district manager since 1952, will head the consolidated district which now includes sales offices at Tulsa and Oklahoma City and branches at Blackwell, Duncan, Seminole and Oklahoma City.

Pool has been with BS&B nearly 20

NOW!

for Heavy

Ford's new fully automatic transmission provides six forward speeds . . . multiplies engine torque over 14 times for fast getaway and heavy going . . . retards speed on downgrades!

SAVES WORK! Just flick Transmatic's control lever to the desired driving range and you're done with shifting! Transmatic Drive thinks and works for you, ending the strain of constant shifting!

SAVES TIME! Transmatic Drive keeps loads *moving!* Starting torque is nearly double that of conventional transmissions. It automatically selects the right gear! You get away fast, reach high gear sooner! Transmatic ends shifting lag: maintains momentum!

SAVES FUEL! At cruising speeds you operate economically in direct drive with torque converter locked out! Under *all* driving conditions, Ford's new Transmatic Drive keeps engine speed within the most economical, most efficient range!

SAVES MAINTENANCE! Transmatic's hydraulic retarder acts as a built-in brake; saves service brakes! Clutch maintenance is eliminated. The power train lasts longer because shock loads are hydraulically cushioned—a critical factor on off-road jobs!

Transmatic Drive is another reason why Ford Trucks cost less . . . less to own . . . less to run . . . last longer, too! Call your Ford Dealer; he'll gladly come out, at your convenience, with full details including model application data!

Easier going up
No shifting lag. Transmatic preserves your momentum . . . automatically!

Easier going down
Sure control! The retarder acts as built-in brake; saves service brakes!

Easier on the level
No-shift driving in traffic; the right gear always!

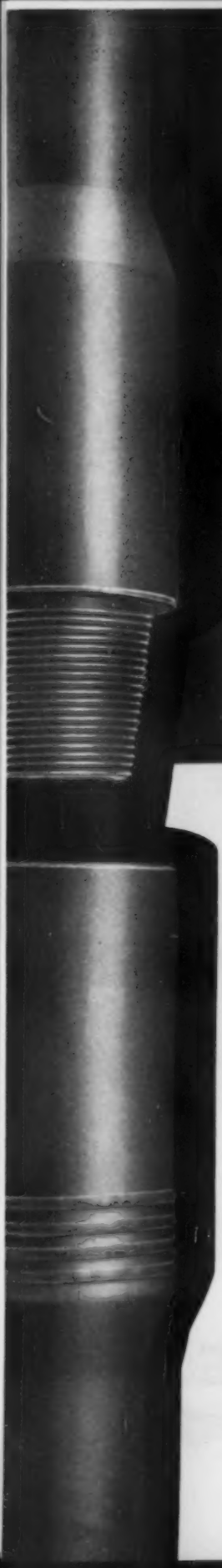
TRANSMATIC DRIVE

Duty FORD TRUCKS!

Time-saving, money-saving Transmatic Drive and Ford's Heavy Duty trucks make a tremendous team to help you get more work done at less cost. Both are designed and built to last longer and give you a better return on your investment.

FORD TRUCKS COST LESS

...LESS TO OWN ...LESS TO RUN ...LAST LONGER, TOO!



J&L DRILL PIPE

J&L Supply offers you a dependable source of high quality drill pipe for deep or shallow drilling, and to accommodate various types of tool joints.

Available in Grades D and E, Blue Ribbon Heat Treated Alloy, and Blue Ribbon Plus Vanadium Heat Treated Alloy steels (105,000 psi. minimum yield).

Interested, capable service everywhere — call your nearest J&L Supply representative.

The deepest well in the world, drilled in South Louisiana from the barge Keystone with J&L Blue Ribbon Plus Vanadium Drill Pipe to total depth of 22,570 feet. There was not a single pipe failure.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

SERVING THE UNITED STATES AND CANADA 21-S

years. For several years he managed the branch at Odessa, Tex., and was promoted to district sales manager at Abilene in 1952, where he served for 18 months prior to his transfer to Oklahoma City. Byers started with BS&B in 1936 and has remained in Tulsa during the entire period.

Gardner-Denver Elects Three Vice Presidents

GUTEKUNST

George W. Gutekunst, C. H. Rieman and Brice D. Maddox have been elected vice presidents of Gardner-Denver Co., according to Gifford V. Leece, president. Gutekunst was named general sales manager in 1954 and continues in this capacity. Prior to 1954 he served as Gardner-Denver's district manager in Los Angeles. Gutekunst has been with the company's sales organization since 1937.

Rieman was formerly sales manager of mining and construction equipment until transferred to the Denver plant in 1955. He was named general manager of the Denver plant in February 1957. Reiman joined Gardner-Denver in 1937 and has served in sales in Quincy and San Francisco, and as district manager in Duluth.

Maddox was appointed general manager of the Keller Tool Division, Grand Haven, Mich., last year and continues in this capacity. He joined Keller Tool Co. in 1951 as materials control manager and in 1953 was named manager of employe relations. In 1955 Keller Tool merged with Gardner-Denver.

B&W Elects Vice President For Tubular Products

J. S. ANDERSON

James S. Anderson has been elected a vice president in charge of sales for the tubular products division of Babcock & Wilcox Co., according to Edward A. Livingstone, vice president in charge of the division. Anderson will continue to headquarter in Beaver Falls, Pa.

Anderson joined B&W in 1941 as a district salesman in the division's New York office. He was named assistant manager of that office the next year and assistant general sales manager of the division in 1948. He was promoted to general sales manager in 1953.

Otis Appoints Mitchell New Iberia Superintendent

Bill T. Mitchell has been appointed district superintendent in New Iberia for Otis Pressure Control, Inc. He was formerly assigned to the firm's West Texas division in Odessa. He held a similar position with Otis in South Louisiana prior to his assignment in West Texas.

At the same time, Otis announced the transfer of Bill Hill, southern Louisiana division manager, from New Iberia to its newly established offices in the America Fore Insurance Building in New Orleans. Hill directs Otis operations in New Iberia, Houma, Harvey, Lake Charles, and Belle Chasse. The firm has had branch facilities in Louisiana for 18 years.

Richard Newton Joins First National City Bank

Richard R. Newton has joined the petroleum department of the First National City Bank of New York as a petroleum engineer.

Previously he had been a corporate

WHEN IT COMES TO SERVICE COME TO REILLY

Dick Renshaw is well known to all Reilly Enamel users because he heads up Reilly's Hot Enamel Field Service Group.

He is a practical Corrosion Engineer and has an intimate knowledge of the composition of enamel and of the techniques of its manufacture and use. As a result, his capabilities are held in high esteem throughout the industry.

Reilly COAL TAR PRODUCTS

Reilly Tar & Chemical Corporation
MERCHANTS BANK BUILDING, INDIANAPOLIS 4, INDIANA
Sales Offices in Principal Cities

officer and a petroleum engineer for Smith Newton Oil Co. in Bradford, Pa., and an engineer with Continental Oil Co., Ponca City, Okla.

Southern Pipe Coating Opens Atlanta Plant

Southern Pipe Coating Co. has opened a plant in Atlanta, Ga., to apply coating and wrapping to gas and gasoline transmission pipe. The firm occupies a 17-acre $300,000 plant just completed in Doraville, an Atlanta suburb. Sales offices are in Atlanta. J. C. (Chris) Matthews is sales manager.

Features of the plant are its automatic handling of pipe to secure coating and wrapping of high quality and the 17-acre facilities for storage of bare pipe. It is designed to process 12 miles of pipe a day and eventually will be on a three-shift operating schedule.

In addition to the automatic handling equipment, Southern Pipe Coating's facilities include a double Holiday detection test for locating defects in coating or wrapping.

The large area set aside for pipe storage will allow customers to store all pipe before processing and then have it shipped directly to the job site immediately or shortly after coating.

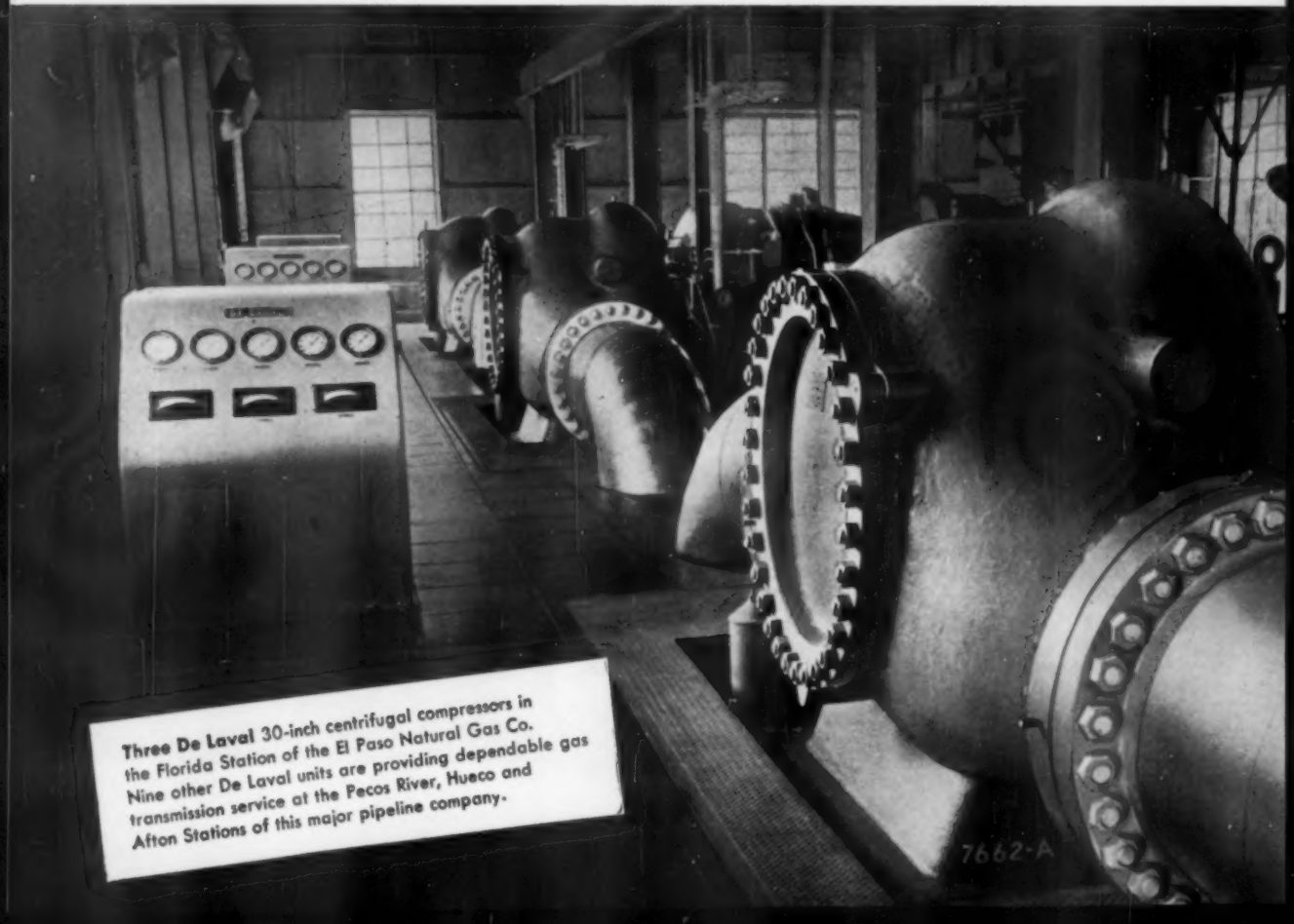
Matthews was with Allied Chemical & Dye Corp.'s Barrett division for the past 8 years handling sales and servicing of coal tar enamel applications.

New Bovaird Store Replaces 31-Year-Old Structure

Bovaird Supply Co. opened its new store at Borger, Tex., on May 10. The original Bovaird store opened at Borger in 1926 and was reinforced and enlarged several times during the years to serve the expanding Panhandle area.

Many Bovaird officials attended the formal opening, including Davis D. Bovaird, president; Roscoe G. Ayers, vice president and general manager; Raymond E. Batchelor, vice president and sales manager; W. J. Bovaird, general manager of stores; and R. M. McMahon, secretary.

The Bovaird Panhandle district is supervised by R. E. Whitten, general manager at Amarillo. Tom E. Pierson is store manager at the new Borger store, and R. F. Ewing is store manager at Pampa.



Three De Laval 30-inch centrifugal compressors in the Florida Station of the El Paso Natural Gas Co. Nine other De Laval units are providing dependable gas transmission service at the Pecos River, Hueco and Afton Stations of this major pipeline company.

Newton Elected President Of Norvell Wilder Supply

J. W. NEWTON

John W. Newton has been elected president and general manager by Norvell Wilder Supply Co.'s board of directors. He formerly was vice president and general manager of refining for Magnolia Petroleum Co. and had retired as the Magnolia refining chief after 43 years of service with that company only 2 days before his selection.

Already a member of the Norvell Wilder board, Newton succeeds the late Frank S. Carothers. Carothers also served as Houston branch manager and Newton immediately appointed Herman H. Berwick as acting branch manager in Houston and Henry F. Peebles as acting assistant branch manager there. A Colston, vice president and branch manager of Corpus Christi operations, will spend some time in Houston in an advisory capacity to Berwick.

Otis F. Abbott has been in charge of the machinery department in the Houston branch, assisted by E. E. Smith. Abbott and Smith will continue to headquarter at Houston but will be available to all Norvell Wilder branches and sales offices as needed.

Norvell Wilder has headquarters in Beaumont, Tex., with branches in Houston, Corpus Christi, Fort Worth, Odessa, and Conroe, Tex., and at Shreveport and Lake Charles, La. Sales offices are in Port Arthur, Dallas and Tulsa.

Oilwell Makes Gulf Coast, Canadian Appointments

The appointment of Stuart J. Stein as manager of the Morgan City, La., store of United States Steel Corp.'s Oil Well Supply Division has been announced by M. F. Jones, Gulf Coast area manager of the division. Edward N. Spice has been named district production engineer, Edmonton, Alta., according to W. A. Weir, Canadian area manager.

Stein was employed by Oilwell in 1950 at Harvey, La. In 1953 he was appointed field representative at that location, the position he held prior to his present appointment. Spice was employed in 1954 as an engineer trainee. Later that year he was appointed assistant to district engineer at Wetaskiwin, Alta., and in 1955 was transferred to Red Deer, Alta., and in 1956 to Edmonton.

Orbit Names Bostick as Field Representative

J. W. BOSTICK

James W. Bostick has been appointed field representative for Orbit Valve Co. in the Ark - La - Tex area according to L. E. Wallace, general sales manager for Orbit Valve. Bostick will headquarter at Shreveport and work under the direction of James W. Bowling, Orbit's division manager, Dallas, Tex.

Otis Opens New Branch In Farmington, N. M.

Otis Pressure Control, Inc., has opened a district office in Farmington with Byron (Pete) Levisay in charge of the new branch. Prior to joining Otis, he was with Magnolia Petroleum Co. for several years.

Otis manufactures and markets a line of special subsurface controls for oil and gas wells and also operates a large fleet of special wire-line service units. The firm has branch offices in

DE LAVAL

CENTRIFUGAL COMPRESSORS

on the job at El Paso Natural Gas

De Laval centrifugal compressors offer many important engineering features. (1) They are designed to handle an increased ultimate flow, can be quickly converted to larger capacities by replacing the impeller, diaphragm and a few minor parts. (2) The high pressure shaft seal eliminates leakage, consumption of sealing oil is negligible. (3) There is only one moving part—the rotor—which has ample clearance. (4) Units are compact, require smaller foundations and smaller stations. (5) First costs and installation costs are low.

Bulletin 503 gives data on De Laval Centrifugal Compressors. Write for your copy.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY

810 Nottingham Way, Trenton 2, New Jersey

DL575

major producing areas in the Mid-Continent and Gulf Coast regions. Its general offices and manufacturing plant are in Dallas.

Otis has had a branch in New Mexico for 20 years, first opening in Hobbs in 1937. New Mexico facilities are under the company's western division in Odessa, Tex. Jack Russell is the division manager in Odessa.

Lynch Manages New Iverson Store at Cortez, Colo.

J. R. LYNCH

Iverson Supply Co., Tulsa, has opened a new supply store in Cortez. It will serve the Four Corners area of Colorado, New Mexico, Utah and Arizona.

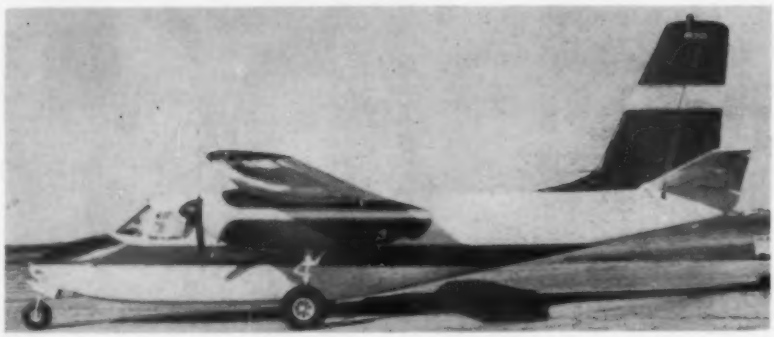
The new store will offer a complete, around-the-clock service for the oil industry and will be able to draw additional supplies from the Iverson store in Farmington, N. M., during rush periods.

The Iverson staff at Cortez includes J. R. (Dick) Lynch, store manager, formerly field salesman for the Farmington store; J. E. (Ed) Chaney, field salesman, formerly store man at Sherman, Tex.; and James R. Roberts, store man, previously with the Iverson Supply store in Odessa, Tex.

Harold Brown Co. Adds Sales Representatives

Earl K. Moore, P. S. Ervin, W. H. Seyffert, Jr., F. M. McGinn, H. M. McFall and Bill Horton have been added as sales and service representatives for Harold Brown Co., Inc. in Texas, Louisiana and Oklahoma.

Moore will be in Midland, Tex.; Ervin in Abilene, Tex.; Seyffert in Corpus Christi, Tex.; McGinn, Lafayette, La.; McFall, Houma, La.; and Horton in Guymon, Okla.



Cameron Adds Aero Commander to Service Facilities

This five-place, twin-engine Aero Commander 680 has been added to the service facilities of Cameron Iron Works, Inc., Houston. Willet Alsworth, Jr., formerly with Goldston Oil Corp., has been named to head Cameron's aviation department.

Lewis, Groh, Aker Named As Welex Sales Engineers

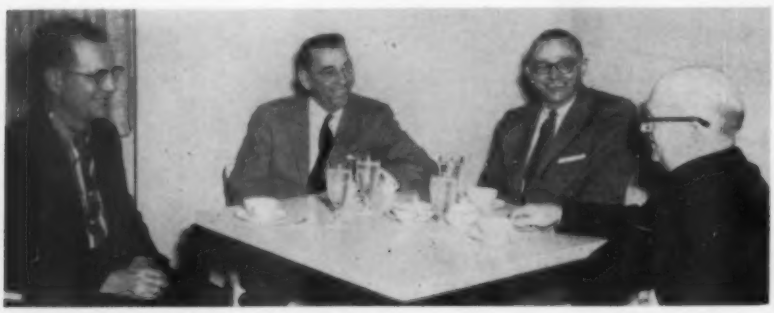
Jack A. Lewis, Vernon E. Groh and Graham W. Aker have been named sales engineers for Welex Jet Services, Inc., Fort Worth oil-well service company.

Lewis has been promoted to sales engineer for the Hobbs, N. M., district office. He started in the field as a roughneck 6 years ago. During the time he has also been a roustabout, gage operator, rigman and shooter. Groh has been promoted to sales engineer for the Odessa district office. For the past 3 years, he has been in oil-well service work, most of this time with Welex. He worked as rigman and shooter until his recent appointment. Aker has been promoted to sales engineer for the Wichita Falls district office. He has spent 5 years in oil-well service work, starting as an engineer trainee and later moving from a trainee to an R/A operator with Welex.

Larkin of Butler Appoints Thomas to Sales Post

William J. Thomas has been appointed sales representative by Larkin of Butler to serve Kentucky, southern Ohio, West Virginia, North Carolina, South Carolina and Tennessee as well as water-well jobbers in North Carolina, South Carolina and Tennessee.

Prior to this appointment Thomas was with Jones & Laughlin Supply Division.



Halliburton Official Plans Inspection of European Oil

Ralph R. Emery, Halliburton Oil Well Cementing Co.'s vice president for foreign operations and export sales, second from left, is planning a 90-day tour of European oil centers, visiting Halliburton subsidiary operations in Germany, Italy, Austria and Sicily. During Emery's absence his duties at Hallibturon's Duncan, Okla., headquarters will be handled by M. W. (Cy) Reed, second from right, vice president and general manager of Halliburton, Ltd., Calgary, Alta., Canada.

Others shown discussing the trip are R. G. Kelly, right, senior vice president, and Leo Mermis, left, Duncan office manager for Halliburton's export department.

M-H Promotes Mallory to Southwestern Manager

R. L. MALLORY

R. L. Mallory has been promoted by Minneapolis-Honeywell Regulator Co. to manager of the firm's southwestern sales region with headquarters in Dallas. He succeeds Frederick C. Brandt, who has been named manager of technical services for Honeywell's commercial division and transferred to the firm's executive offices in Minneapolis. Brandt had been Southwest regional manager in Dallas since 1952.

Mallory joined Honeywell in 1933 and after 2 years as a research engineer in Philadelphia was assigned to the firm's sales office in Houston. While there he served as district sales

manager and subsequently as branch sales manager. He had been regional industrial sales manager in Dallas since 1952.

J&L Supply Transfers Landis to Alice, Tex.

Robert D. Landis, sales representative, has been transferred from Odessa to Alice, Tex., according to W. L. Wolfe, vice president-sales, Jones & Laughlin Supply Division, Tulsa.

Landis began his J&L career as a storeman at Odessa in 1947. In 1953 he was promoted to salesman and has remained at Odessa until his recent move to Alice.

Johnson Joins Enardo's Product Design Staff

Gene Johnson has joined the product design staff of Enardo Manufacturing Co., Tulsa, Phil B. Drane, Enardo president, has announced.

Johnson has been working in the California aircraft industry, specializing in fuel and oil systems. He will assist in the development of new products. Enardo produces a wide range of oil-field valves, slip-on fittings and other specialty items.

Homco Promotions and New Assignments Are Announced

Personal promotions and new assignments announced by Houston Oil Field Material Co., Inc. include: Exey J. Belaire, New Iberia to Morgan City; Clarence Bledsoe, Edmonton to Calgary; Robert J. Bradshaw, Liberty to Houston; Pat J. Bullard, Beaumont to Bay City; Albert F. Coleman, fishing tool supervisor, Sherman, to sales and service repair, Houston; Clyde D. Doyle, New Iberia to Morgan City; John B. Floyd, Hattiesburg to Houston; A. B. Foreman, Jr., sales engineer to manager of production engineering, Houston; D. O. Herdejurgen, Bay City to Houston.

Kent L. Kramer, Lakes Charles to Houma; Wayne E. Larson, Edmonton to Calgary; Paul J. Mentzel, Jr., Edmonton to Calgary; Robert L. Nelson, Houston to New Iberia; Carl W. Orth, Jr., Edmonton to Calgary; Thomas F. Posey, Edmonton to Houston; James Rathburn, New Iberia to Harvey; Thomas E. Russell, Houston to Beaumont; Edward A. Scown, assistant chief engineer to manager of training, Houston; Harold F. Streit, assistant district manager directional drilling to district manager, Edmonton; Bobby G. Tam, New Iberia to Morgan City; D. H. Whitman, Williston to Edmonton.

H-F
3-TUBE
Rx for pumping abrasive fluids
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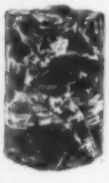

Core Lab is now distributing complimentary copies of AAPG's new 36-page publication — Sample and Core Repositories of The United States, Alaska, and Canada. Send request on your company letterhead to address below. Please mention this publication.

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EXPLORATION

Another Salt Barrier Falls

By Frank J. Gardner

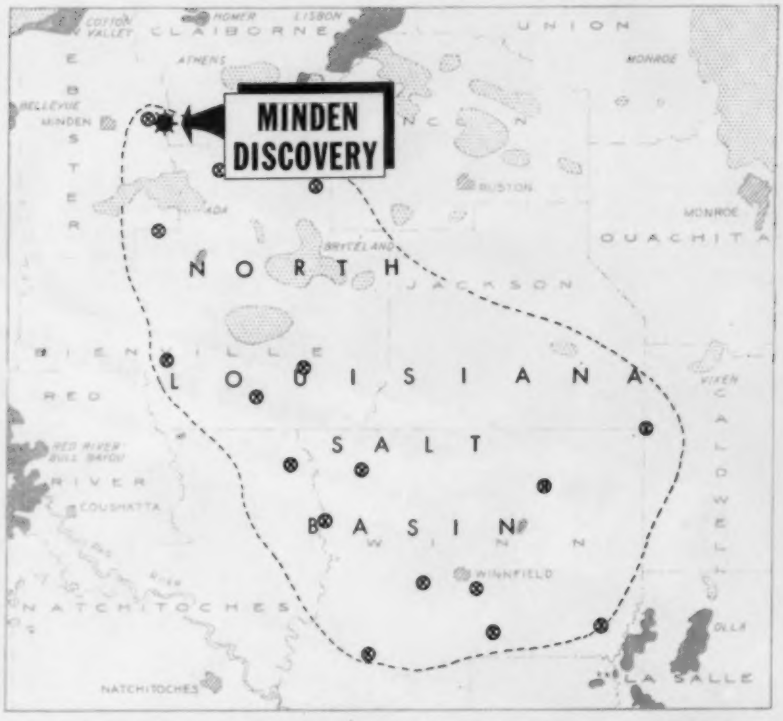
DISCOVERY of oil on Spindletop salt dome in 1901 changed the history of the world. Since then, hundreds of other domes have been found, and the mineral wealth that has flowed from them as petroleum, salt, and sulfur is inestimable.

In the Gulf Coastal region, oil finders are still probing these domes and are still finding new pools; Spindletop itself is no exception. Salt-dome experts predict, as a matter of fact, that the next 50 years will produce as many new oil fields on these structures as have already been found.

The simple truth is this: despite the thousands of wells that have been drilled on them, and despite the wealth of data, research projects, theories, and publications that have stemmed from this drilling, we still don't know enough about their origin, nature, and effects to exploit them efficiently. They are bigger than anyone ever imagined—this much we have learned; bigger in regional influence, bigger in productive potential, and bigger in structural complexity.

A hundred challenges . . . Knowing these things, why do so many of them lie unexplored? No other type of structure holds such enticing challenge for the oil hunter. Yet, nearly a hundred totally or inadequately drilled piercement salt domes await exploration in Texas, Louisiana, and Mississippi.

Last year, the industry was reminded of these possibilities when British-American Oil Producing Co. opened deep Cretaceous production on the Hainesville salt dome in Wood County, East Texas. The discovery set off a wave of leasing across all of East Texas, North Louisiana, and southern Mississippi—wherever a dry salt dome was known to exist. As a result, leases today are hard to come by on any of them. Following the Hainesville strike, several wildcats were announced for other East Texas domes; a second success was scored at Bethel dome in Anderson County, and East Texas began to realize that its long-dormant nest of 16 dry domes might mean money in the bank.



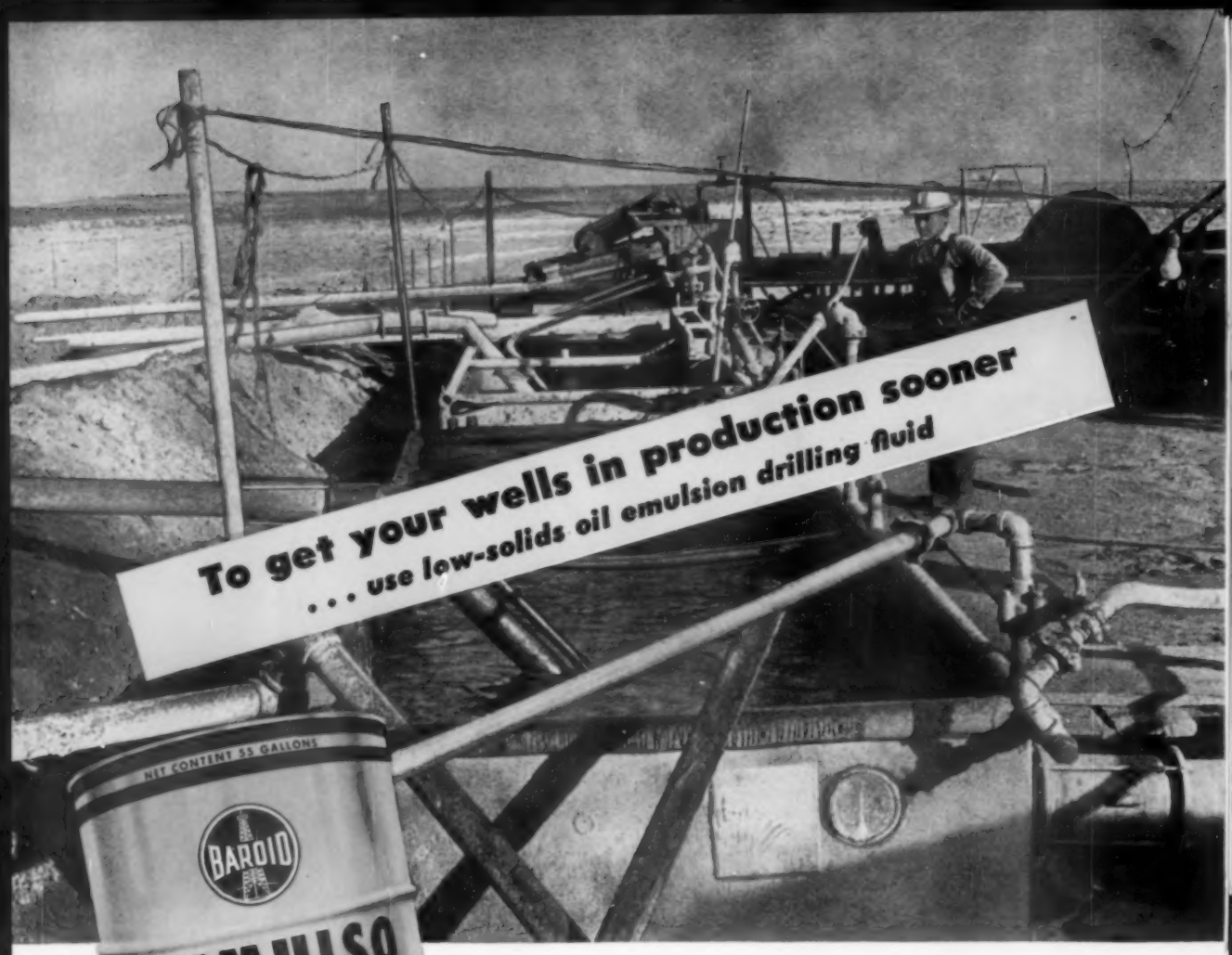
FIRST PRODUCTION on North Louisiana's 17 piercement salt-dome prospects has been found. Pan American's 1 Hudson foretells new salt-dome exploration in the future.

Now, North Louisiana operators should realize the same thing. They have 17 dry domes. Or they did, until last week, when Pan American Petroleum Corp. found the first salt-dome field in the North Louisiana salt basin. At its 1 Hudson, on Minden dome, Webster Parish, Pan American completed in the Paluxy-Lower Cretaceous at 7,460-66 ft. for 9,000 M.c.f. of gas per day plus 13 bbl. of 58° condensate per million. The discovery lies in Section 21-19n-8w, on the eastern flank of the piercement salt spine.

And one success . . . Pan American worked long and hard on this one. Spudded on August 31, 1956, the operation stretched out over 8½ months. And it was expensive. But the company proved its point. For the past 6 years, Minden has been under study. Gravity surveys, followed by seismic check and subsurface study, preceded the decision to drill. Only four or five tests had ever been sunk in the vicinity of the known cap rock; the deepest of these had quit at 3,085 ft. on the northwest flank. But Pan American was a bit more inquisitive; it carried the 1 Hudson to 11,604 ft., where the bit entered the salt stock, and plugged back to 7,480 ft. In all, the wildcat recorded no fewer than 75 separate shows of oil or gas; the best of these were in the Navarro-Upper Cretaceous at 3,100 ft. in the Paluxy (the completion horizon), and in the lower Cotton Valley-Jurassic at 9,490-9,612 ft. The Cotton Valley flowed 1,300 M.c.f. gas and 15 bbl. per million on drill-stem test, and it is possible that a dual discovery completion may eventually be made here.

Many interesting things were found during the drilling of this well. Evidences of faulting indicate that structural complexities exist all around the dome, and that these could hide numerous off-flank traps. An old Gulf Oil Corp. test on the crest of the dome had found the salt at 1,583 ft.; Pan American found it at 11,590 ft. On surface elevation of 377 ft., the discovery topped the Upper Cretaceous at 2,765 ft., the Lower Cretaceous at 5,871 ft., Paluxy at 6,550 ft., and the faulted top of Cotton Valley at 9,100 ft.

Mean many more to come . . . But the most interesting thing of all about this discovery is the inference of many other discoveries to come in strike-hungry North Louisiana. There are 16 more of these piercement domes still awaiting the drill. And if it can happen at one, it can happen at all. Oil finders, please note.



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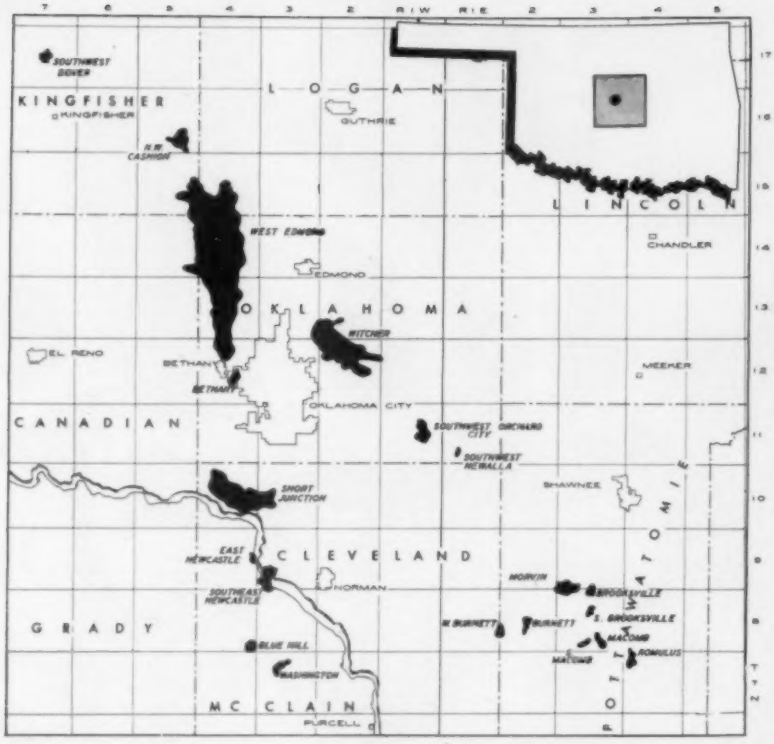


CURRENTLY there is an intensive search for Hunton production in Central Oklahoma. The two largest Hunton pools, both strat traps, are West Edmond and Short Junction. Fig. 1.

Part 1

of a two-part article. Part 2 will be published next week, June 10.

Woodford shale with pebbles of Bois d'Arc.

←——Contact

Bois d'Arc.

Chimneyhill lime.

←——Contact

Sylvan shale.

THE UNCONFORMITY at the top of the Hunton is apparent in this core. Notice the contact with the underlying Sylvan shale is conformable. Fig. 2.

In Central Oklahoma . . .

Bois d'Arc Pay Spurs Limestone Exploration

The story of the accumulation of oil and gas in the Bois d'Arc member of the Hunton group.

By Ed Barrett and Eugene F. Culp

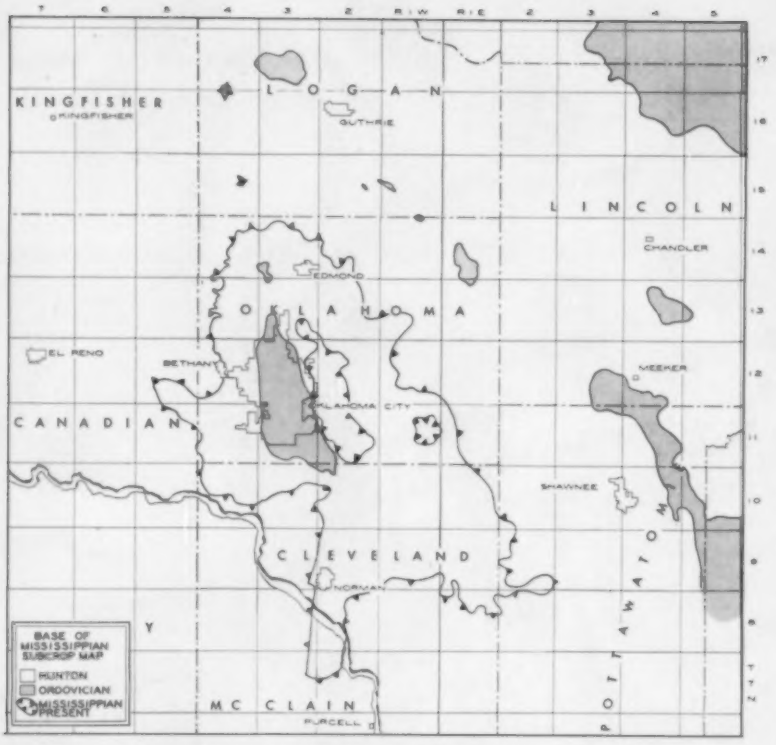
AN incentive for rapid expansion of exploration for limestone reservoirs has been provided by Bois d'Arc production from the Short Junction pool. This is in striking contrast to the pall of pessimism so prevalent in the period between development of the West Edmond and Short Junction pools. The industry's enthusiasm for Hunton possibilities had reached a low ebb. Formerly one heard nothing but the cry of robber when any Hunton prospect was mentioned: today, operators are actually competing for Bois d'Arc prospects. This article is a classification of the Bois d'Arc production within Central Oklahoma. It presents most of the significant data which will aid in exploration, development, and production. (See Fig. 1.)

Stratigraphic and Structural History

The lithology, structure, and geologic history of Central Oklahoma strata are easily understood. This understanding is part of the intangible equipment used by most of the workers in search of oil and gas. It may prove helpful, however, to review some of these factors from a regional standpoint to explain some of the specific details.

By combining the stratigraphic, structural, and geologic history we shall present the chronology of events which were instrumental in trapping oil and gas in the Siluro-Devonian limestones.

Depositional patterns . . . Oklahoma did not receive sediments of the Paleozoic era until late Cambrian time, when most of the Mid-Continent area was inundated. In the ensuing interval until late Ordovician time the area now known as Oklahoma was situated along the axis of a great embayment, the deeper portion of this embayment extended from the open sea northwestward into Colorado. This great negative region was bounded on the northeast and north by Ozarkia and the continental craton. It was bounded on the southwest and south by the ancestral positive area extending from the present vicinity of the Rocky Mountains southeastward through New Mexico and West Texas. These predominantly positive features were subject to sporadic fluctuations; consequently, they were inundated for very limited periods.



PRIOR TO MISSISSIPPIAN DEPOSITION there was an important erosional period. During this time the Oklahoma City uplift was eroded. Fig. 3.

The depositional pattern and the lithologic character of the Upper Ordovician—Sylvan shale indicate for that epoch a widespread, shallow sea over a broad platform area of very quiet conditions and slow deposition. It was limited on the northeast and north by Ozarkia and the Kansas uplift.

Chimneyhill limestone of early Silurian age represents the first Hunton to be laid down in this area. This limestone with its abundant fossil fragments is correlated, in part, with the Alexandrian Brassfield-Lower Silurian limestone of the Ozark Mountain, Interior basin, and Appalachian basin provinces. There is no pronounced break between the Sylvan shale and the Chimneyhill limestone except in the Ozark region. However, the hiatus is represented in the Appalachian basin and in the marginal geosyncline bordering the cratonic mass by sand-bearing gray to red shales of early Silurian age. These basal Silurian sediments did not reach westward into Oklahoma from their major source area in the Adirondack-Appalachian chain except, perhaps, by entering southeastern Oklahoma via the Ouachita geosyncline. (See Fig. 2.)

The Ozark uplift continued, throughout late Ordovician, Silurian, and Devonian time, to limit deposition, exerting the control which directly affected the Central Oklahoma area. With the exception of minor and rather limited warpings on the broad Mid-Continent platform during Hunton time, no dramatic disturbances affected sedimentation. It is for that reason that subtle lithologic variations must serve to unravel the problems of the contemporary history of Hunton deposition.

Radical variations of thickness and content, as noted in the major basins bordering this area, are in great contrast to the comparative uniformity of local Siluro-Devonian rocks. Here, the Hunton is rather arbitrarily divided by assigning the Chimneyhill limestone and the Henryhouse dolomitic limestones and shales to the Middle and Lower Silurian, respectively, and calling the Haragan limestone and shale and the overlying Bois d'Arc limestone Lower Devonian or Helderbergian. In general, the Chimneyhill limestone at the base of the Hunton, and the Bois d'Arc limestone of upper Hunton are very similar; they both contain abundant fossil remains with a volumetric preponderance of crinoid fragments; both have about the same light gray to buff color variations with pink crystals and yellow discoloration; both are oolitic in part; and both exhibit coarser than average crystallinity with very little shale development.

In the interval between the deposition of these two similar limestones, the Henryhouse and the overlying Haragan dolomitic shales and limestones give evidence of slightly deeper seas with less variation of color, finer texture, and sparser fossil content.

The above generalizations for the entire Hunton platform area apply to a great extent to most of Oklahoma where Hunton is present, except for the Ouachita geosyncline.

The Chimneyhill and Bois d'Arc, along with the intervening Henryhouse and Haragan, contain only very negligible amounts of coarse, insoluble clastic material. This, combined with the gradual change from generally coarse limestones at the base, through the finer phase, and then back to coarse limestones of upper Hunton, argues for relatively undisturbed sedimentation throughout, with source areas of low relief.

Structural movement . . . The first pronounced structure building and truncation of Hunton beds evidently occurred during the long middle and late Devonian epochs. That the Acadian orogenic movements were strongly felt in this area is evidenced by the fact that the basal unconformity sand or detritus zone, (Misener-Sylamore), underlying the Woodford shale of lower Mississippian, is in contact with a truncated surface varying from Cambrian in northeastern Oklahoma to upper Hunton in Central and southern Oklahoma (See Fig. 3).

The Ozarks, part of the Ouachitas, and portions of the Nemaha ridge were strongly affected by this series of movements which provided the first weathering period for the Hunton lime-

THE AUTHORS

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E. F. CULP

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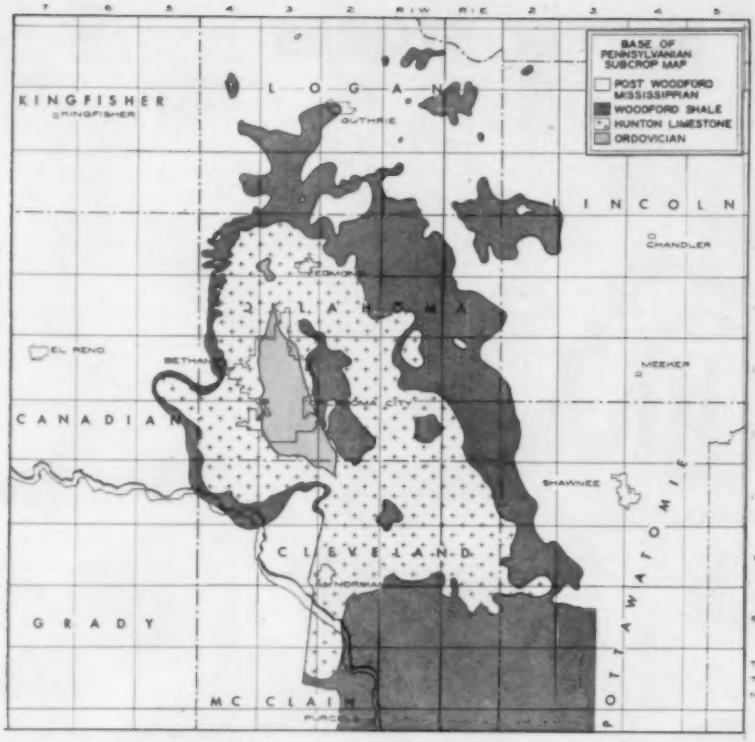
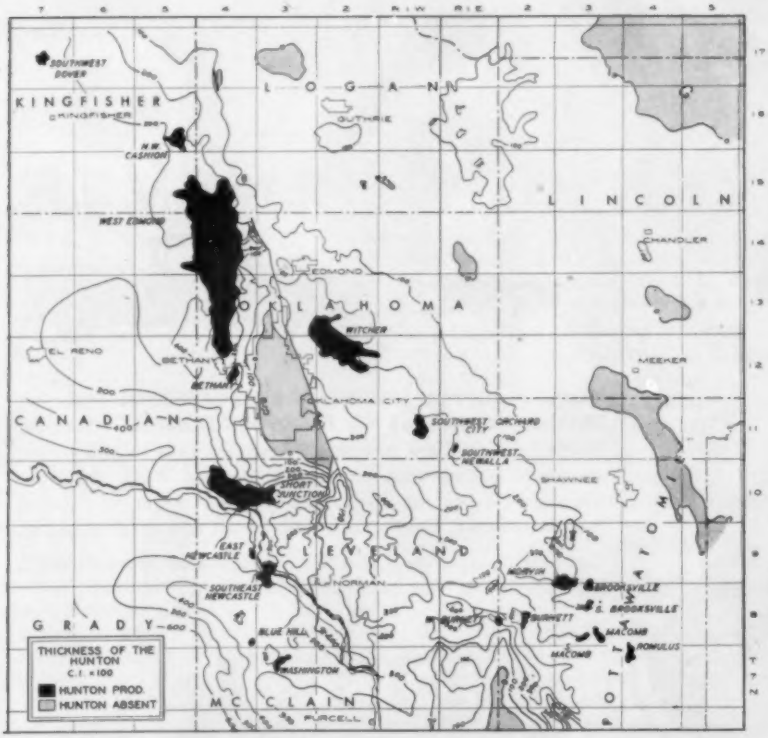
Eugene F. Culp is division geologist for Continental in Oklahoma City. He was an instructor in geology at Oklahoma University from 1948 to 1951 and has worked with the U. S. Army Engineers, Arkansas Geological Survey, and other oil companies. He received his degree in geological engineering in 1939 and Master of Geological Engineering in 1950 at Oklahoma University. Culp is a member of Sigma Gamma Epsilon and Sigma Xi.



SUBCROP MAP shows the areal distribution of beds prior to Pennsylvanian deposition. The structural trends are easily distinguished from the subcrop pattern. Fig. 4.



MOST OF THE HUNTON PRODUCTION comes from the Bois d'Arc member in the upper part of the Hunton. Both Short Junction and West Edmond are well down on the flank of the Oklahoma City uplift. Fig. 5.

stones. There is no doubt these disturbances caused a great deal of minute fracturing in the strata being exposed, as well as in the lower and as yet unexposed beds.

Eventually the lower Mississippian-Woodford shale overlapped the entire area and filled in the valleys and channels. The same type of broad, undulating warping of Hunton time occurred during Mississippian and early Pennsylvanian time, but with some localities being subjected to disturbances of greater magnitude than others. This is witnessed by the erratic thicknesses and content of sediments which were coming from a wide variety of sources. Operation "Mixing Bowl" took place with such gradations as Sycamore sandy limestone to Osage siliceous limestone, Mayes and Caney limestones and shales to Meramec sandy and cherty limestones, and from Caney and Goddard shales to Chester limestones and shales. This heterogeneous system indicates widely differing source areas and materials from which the Central Oklahoma area received sediments of varying lithologic character.

Weathered zones of Mississippian siliceous limestones of Osage age are overlain by unweathered Mississippian limestones along the western flanks of the Nemaha ridge in northern Oklahoma. This is indirect and circumstantial evidence that some of the greater prominences such as the Oklahoma City uplift but not specifically this uplift, may have been exposed during early and middle Mississippian time for the second time in their histories. The first was the previously mentioned late Devonian interval.

In early Pennsylvanian time, much of the area was covered by onlap of Springer-Morrow sediments; after this, the Wichitan or post-Springer orogeny resulted in the elevation and rejuvenation of the Central Oklahoma platform area, the Nemaha ridge and associated structures, the Ozarks, and parts of the Arbuckles and Ouachitas.

The truncation which followed removed the shoreline facies of the Springer-Morrow group from most of the area, leaving the truncated edges of the deeper basinal sediments exposed around the margins of the positive features. Western Oklahoma was not greatly affected by this movement and the so-called Morrow or shelf facies of the Springer-Morrow group was preserved. (See Fig. 4).

Trancation during this period exposed rocks of Arbuckle through lower Pennsylvanian age. The pre-Pennsylvanian subcrop map illustrates the magnitude and extent of this bevelling action; Mississippian, post-Woodford rocks covered the whole

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state with the exception of a few small areas, yet broad areas suffered total removal of these sediments in addition to the underlying Woodford. During this mountain-destroying epoch, during which Atoka and lower Des Moines sediments were wedging out by onlap, an erosional environment very similar to that of the pre-Woodford epoch was recreated. In the area of this report, however, the destruction was on a much grander scale than that of late Devonian, but along the same general lines of weakness. New channels were cut, many being along entirely new directions and some being superimposed upon the old channels of late Devonian age. The greater degree of fracturing and faulting at this time undoubtedly had much influence on the direction of channel cutting, as did the attitude of the exposed structures themselves. As erosion progressed, broad valleys of old age developed leaving isolated limestone hills in the divides. (See Fig. 5.)

This second major period of Hunton weathering renewed and increased its porosity and permeability. By Marmaton time the structures thus formed and truncated were overlapped and were not again exposed. This provided the seal for a lengthy period of oil and gas accumulation insofar as Hunton rocks are concerned.

The Arbuckle orogeny which had its greatest upheaval during late Missourian and early Virgilian time exerted enough influence in central Oklahoma to cause further folding and faulting of that already often-disturbed strata. The occasional tremors felt along the backbone of the Nemaha ridge are present-day evidence that minor movement continues.

The Short Junction expansion in February 1955 resulted from the application of the old principle of stratigraphic accumulation in a truncated rock layer. Additional studies were made to determine: (1) the areas having received the greatest amount of weathering, leaching, and fracturing, (2) the zones which, due to their innate lithologic characteristics were most subject to porosity and permeability enhancement through chemical weathering.

Summary

Among the cardinal factors to be stressed in a search for Hunton oil in central Oklahoma, these are of particular importance:

1. Lithologic - character — chemical and textural.

2. Degree of alteration through weathering and fracturing.

3. Thickness of individual, potentially productive strata.

4. Structural position of the reservoir rock.

EXPLORATION HIGHLIGHTS

APPALACHIAN

OHIO

Walhonding pool in New Castle Township, Coshocton County, was extended ⅔ mile to the west by Bell & Ridgeway's 1 (3) Muskingum W. C. District, Lot 4, 2nd Qr. Clinton sand was found at 2,890-2,970 ft. with 3 bbl. natural and 400 bbl. and 500,000 cu. ft. gas in a 24-hour test after fracture.

● Roy Stewart et al moved to the south end of their Radebaugh and Davis lease in Section 1, Baughman Township, Wayne County, and brought in a 5,400,000-cu. ft. gasser. Clinton sand at 3,895-3,903 ft. gaged 3,000,000 cu. ft. natural.

● A third producer was completed in Section 34, Marion Township, Hocking County, confirming a pool. Holl Brothers 1 Gotleib Hugli, with Clinton at 2,708-37 ft. made 50 bbl. 24 hours after fracture.

● Ohio Fuel Co. 1 J. Brown, Section 29, Knox Township, Holmes County, was drilled through the sand to 2,793 ft., and gaged 14,000,000 cu. ft. natural.

PENNSYLVANIA

In Ligonier Township, Westmoreland County, Southwest Pennsylvania, Snee & Eberly completed 2 John Beck wildcat with an initial open flow of 6,700,000 cu. ft. of gas, natural. The Onondaga was at 7,433 ft. chert 7,454 ft., gas 7,466 ft., and total depth 7,536 ft. Elevation of well is 2,845 ft.

● Armstrong Township, Indiana County, Columbian Carbon Co. 1-1840 Fred Musser reached the Onondaga at 7,741 ft., the chert at 7,752 ft., and is running 7-in. casing at 7,753 ft.

● New York State Natural Gas Corp. N-536 William George reached the chert at 7,579 ft., the Oriskany sand at 7,706 ft., and had gas in these formations gaging 1,200,000 cu. ft.

WEST VIRGINIA

In Little Levels district, Pocahontas County, West Virginia, Columbian Carbon Co. has located 4-1269 The Gauley Co., wildcat, elevation 3,209 ft. It is on the Webster Springs Quadrangle 5.24 miles south of latitude 38 degrees 20 minutes and 4.10 miles west of longitude 80 degrees and 15 minutes.

EASTERN KENTUCKY

In Johnson County and located on Dry Branch of Paint Creek, Rice Brothers have reached total depth of 2,265 ft. at their 1 Dude Conley. This test topped Mississippian Weir sand at 968 ft., Corniferous lime at 1,619 ft. and Silurian Big Six sand 2,210 ft. A show of gas was had at 2,212 ft. and operators are shut down pending decision as to whether sand should be shot in an effort to obtain commercial production.

CALIFORNIA

Harnish Discovery Comes in Big

L. A. Harnish completed E53-34F Allison flowing more than 1,000 bbl. daily in a new Gatchell sand deep pool in the Guijarral Hills field, Fresno County. This new pool, which is expected to touch off deep drilling activity in the field, is in the center of the producing area in SW NE 34-20s-16e. Harnish reports the production is clean 30°-gravity crude. The producing interval in the 10,358-ft. well is 10,235-10,338 ft. On an earlier formation test, the wildcat unloaded over the crown block for several hours. Standard Oil Co. of California, Sunray Mid-Continent Oil Co., Continental Oil Co. and Union Oil Co. have offsetting acreage.

Second Riverside Well Finaled

Atlantic Oil Co. gave the recently discovered Prado Dam field, Riverside County, its second well. Atlantic brought in an extension test ¼ of a mile northwest of Lyle Garner's discovery for 50 bbl. daily of 23°-gravity crude, 4 per cent cut, from 3,600-3,800 ft. Garner's discovery was completed last March to put Riverside on

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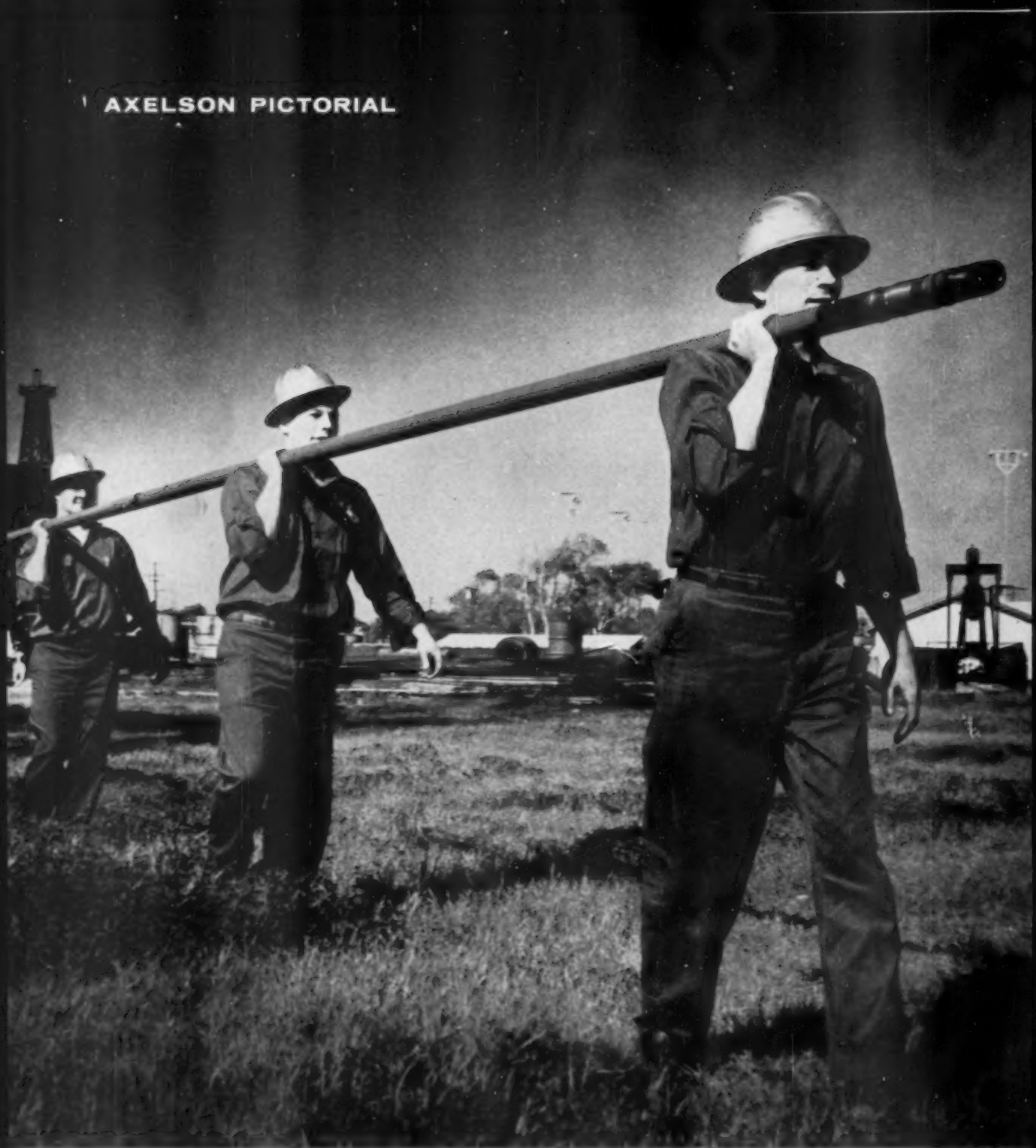
AXELSON PICTORIAL



24 FEET OF PUMP is headed for the bottom of a hole, assigned to offset water encroachment by increasing gross production. This Axelson Volumax is constructed as two pumps in tandem, but lifts maximum volumes because its operation simulates two pumps in parallel. As these units reciprocate, two displacement areas simultaneously fill from the formation and transfer fluid into the tubing string.

In addition to stepping up production at the same cycle rate, the Volumax can assure maintenance of current gross production at an appreciably reduced cycle rate.

To overcome the tendency of this pump to unseat, the patented Axelson friction-ring type cup hold-down was developed. Field use of this new type of hold-down has been consistently successful.

150 to 405 MORE BBLS. PER DAY WITHOUT TUBING JOB

Secret of increased production is in filling of entire expanded annular area during upstroke.

Fluid enters here as in conventional stationary pump.

Production men report that expensive tubing jobs are no longer necessary when they want big increases in volume.

Operators in all parts of the country have found they can usually hit their required fluid rate by replacing an insert pump assembly with an Axelson Volumax.

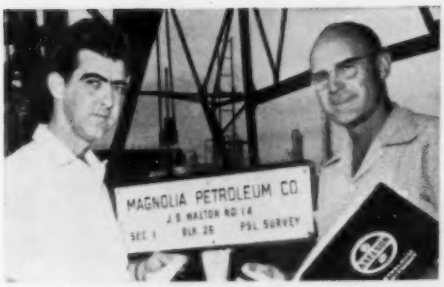
The Volumax is actually two-pumps-in-one with a patented design that allows two displacement areas to simultaneously fill from the formation with each upstroke, instead of the conventional single chamber.

The above diagram shows the extended area that is filled during the upstroke. Velocities of flow are reduced by allowing the larger of the two displacement chambers to fill directly from the standing valve. A lesser quantity of fluid is then required to pass through the restricted seal plunger and pull tube to fill the upper chamber.

On the down-stroke, fluid is compressed, opening the traveling valve and transferring fluid into the tubing.

Ample fluid passages, plus the novel stationary-traveling construction, expedite the entry of fluid from the formation, thereby assuring the maximum fill of the pump during the upstroke.

With any given stroke, a Volumax installed in 2½" tubing allows a 27% displacement increase over a tubing pump. Three applications are pictured at right.



WOULDN'T PUMP DOWN—When the water flood injection rate was increased in Magnolia's Kermit Field, Winkler Co., Texas, the 2¼" tubing liner pump could no longer pump down the well. A VOLUMAX 2½" (2" x 1¼") x 12' x 24' pump was installed, production increased from 360 to 510 bbls/day. Pictured are Axelson's H. E. Summers and Magnolia's C. W. McDonald, assistant production foreman.

HALF OIL, HALF WATER—Richardson Oil's J. F. Hathaway No. 15 in Ward County, Texas, was making 299 bbls. of oil and 302 bbls. of water with a 2¼" tubing pump before a VOLUMAX 2½" (2" x 1¼") x 12' x 24' pump was installed and boosted production to 463 bbls. of oil and 408 bbls. of water/day, with no change in speed or length. Axelson's Summers is with Richardson's B. P. Mathena and J. W. White.

OUTPUT DOUBLED—Axelson service and the VOLUMAX pump again teamed up at Tidewater Oil Company's W. D. Johnson No. 6, also in Ward County, Texas. A 2¼" tubing pump was lifting 430 bbls. total fluid/day with a 54" stroke; this was increased to 835 bbls./day with a VOLUMAX 2½" (2" x 1¼") pump and a 74" stroke. Summers is with O. S. Jones, Sr., a 30-year Tidewater pumper.

AXELSON

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Here's the Ohio Drilling Record for 1956

By George C. Shearrow

DRILLING activities for 1956 follow the same pattern as 1955 with 1,245 new wells having been drilled. Extension of established fields and wildcatting for production in the Clinton sand accounted for over half of the activity in Ohio. The First and Second Berea wells were second and third in number of completions totaling 364.

An increase in the initial production and total production may be attributed to better planning, improved drilling, and completion practices. With the exception of Pennsylvania Grade crude, increases in price came too late to effect the number of wells drilled.

Fifty-six of the eighty-eight counties had completions reported for the year. Of the 1,245 wells completed, 878 were successful and 367 were dry, yielding an average of 29.5 per cent failures. Completions to the Clinton sand accounted for 52.4 per cent of the drilling. Only 18.4 per cent of the 653 completions in the Clinton were dry. The total initial production was 231,122,000 cu. ft. of gas and 42,595 bbl. of oil, of which 198,540,000 cu. ft. of gas and 40,492 bbl. of oil was discovered in the Clinton. Of the 242 wells or 19.4 per cent of the total number of wells drilled, less than 2 per cent of the initial gas and less than 2 per cent of the initial oil came from the Berea.

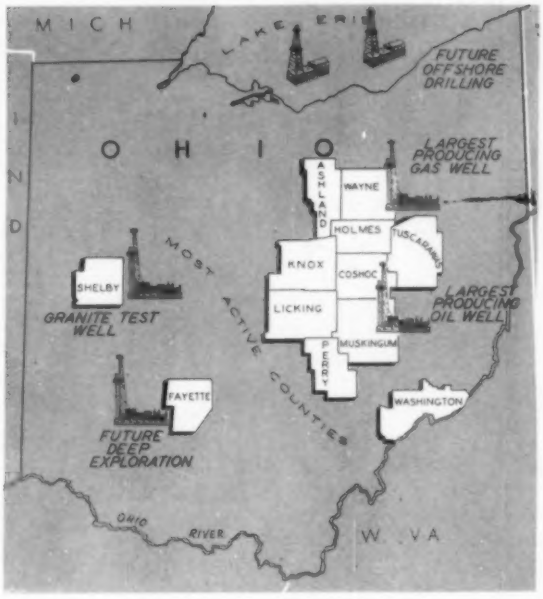
The daily average initial oil production of all new wells, including combination wells, was 63 bbl. a day and 417,000 cu. ft. of gas per day. The Clinton daily average initial oil production was 90 bbl. per day and 547,000 cu. ft. of gas per day for new gas wells, combination wells included.

The old wells drilled deeper totaled 31, of which 14 were dry. The additional daily initial production was 581 bbl. of oil and 2,837,000 cu. ft. of gas.

Secondary Recovery

Area water-flooding permits totaled three during 1956. Two permits were issued for floods in the Berea in Ashland County and the other was issued for the Big Injun in Monroe County. Forty-five wells were completed and 80 were plugged in the eight active counties. The Chatham-Medina area remains the most active flooding area with 708 production and 409 injection wells. The estimated number of wells in all areas is 723 oil and 425 water injection wells.

Author is with Division of Geological Survey, Columbus, Ohio. Article taken from author's "Oil and Gas Developments in Ohio." Copies of this report may be obtained free from Ohio Division of Geological Survey, Orton Hall, Ohio State University, Columbus 10.



DRILLING highlights of 1956 in Ohio are shown in this map. Fifty-six of the 88 counties reported 1956 completions.

Storage

A marked increase in demand for gas during the winter months was responsible for the increase of storage wells completed. A total of 134 wells were added to storage of which 73 were new and 61 were reconditioned. Approximately 1,900 wells are now used for gas storage.

Development

The most active counties were Licking with 143 completions, Coshocton with 127, Ashland with 105, Muskingum with 94, Holmes with 79, Knox and Tuscarawas with 65 each, Perry with 64, Washington with 63, and Wayne with 55. The Berea production in Tuscarawas County appears to be from structural highs in outliers of the Cussewago sand rather than Second Berea as reported by operators. In many instances the Second Berea is absent and Cussewago occupies its position. Many of the wells are being produced natural.

The largest oil well reported was the William Bungard et al. Elsie Carson, located in Section 15n, Hopewell Township, Muskingum County. The well made 10 bbl. of oil and had a small show of gas natural. After fracture it produced 1,200 bbl. of oil and 778,000 cu. ft. of gas the first 24 hours after the fracture oil was recovered. The Clinton sand was found at

TABLE 1—TOTAL OF ALL TYPES OF WELLS COMPLETED FOR 1956

	Number of wells	Production		Number of feet drilled
		Gas (M.c.f.)	Oil (bbl.)	
Gas:				
New	206	151,310	.....	442,253
Drilled deeper	10	1,988	.....	5,684
Storage	.....	.....	.....	.....
Oil:				
New	324	.....	16,669	680,523
Drilled deeper	.....	.....	.....	.....
Combination:				
New	348	79,812	25,926	986,210
Drilled deeper	7	849	581	6,579
Dry:				
New	367	.....	.....	667,020
Drilled deeper	14	.....	.....	6,164
All types:				
New	1,245	231,122	42,595	2,776,006
Drilled deeper	31	2,837	581	18,427
Gas storage	*134	.....	.....	.....
Water flooding	45	.....	.....	.....
Brine, salt, core test	13	.....	.....	29,831
Total	1,468	233,959	43,176	2,824,264

*Including 61 reconditioned wells.

3,274 to 3,346 ft. The oil pay was found at 3,286 to 3,304 ft., and the gas at 3,317 to 3,324 ft.

East Ohio Gas Co. 1 G. M. Gabor well in Section 36, Chippewa Township, Wayne County, had 4,000,000 cu. ft. of gas natural. After fracture the well made 17,300,000 cu. ft. of gas the first 24 hours, and had rock pressure of 1,385 lb. Three sands were noted, two of which were productive.

The stray Clinton sand from 3,795 to 3,809 ft. had pays at 3,826 to 3,831 ft. and 3,836 to 3,840 ft. The White Clinton sand from 3,845 to 3,863 ft. contained the largest pay which ranged in depth from 3,857 to 3,863 ft. The well was the largest gas well Ohio has had for several years.

Five wells were drilled to the Lower Ordovician or older sediments. Gump Oil Co. 1 J. W. and B. Fogt well encountered the granite at 3,306 ft. The granite test was located in Section 3, Salem Township, Shelby County, just north of the pre-Cambrian test drilled by Sun Oil Co. last year. Small shows were reported in the Cambrian but no commercial quantities of oil or gas were found. The four other wells, proposed St. Peter tests, were also dry. St. Peter sand was encountered in the well located in Section 26n, Deerfield Township, Warren County. The sand carried a moderate flow of salt water. Salt water was encountered in the other three wells in the sandy dolomites below the Glenwood.

Although commercial quantities of oil have been found in the Lower Ordovician and Cambrian in several areas these older sediments have not been fully explored. Renewed interest due to the high rate of successful completions to the Clinton sand and other sands of less depth have distracted from the exploration of the deeper horizons.

Future Expectations

With the State of Ohio offering for lease the oil and gas rights below Lake Erie this year, it is expected that the Clinton and possibly the Newburg fields of Cuyahoga County will be extended out under the lake. Techniques developed in drilling on the north side of Lake Erie just off the Ontario Peninsula will probably be adapted to the exploration of Ohio's portion of the lake.

The future of southwestern Ohio may be decided by a large independent oil company which has leased over 425,000 acres in Fayette, Franklin, Madison, Pickway, Ross, Highland, Clinton, Greene, and Clark counties during 1956.

Little geologic data are available on the area although a pronounced gravity anomaly is centered in Fayette County. The relationship of this anomaly to the sedimentary rock sequence is not clearly understood. Widely scattered well records and sample logs tend to indicate that the sediments of Lower Ordovician thin and pinch out to the north. Upper Cambrian and older sediments are known to be present in the subsurface. Small shows of oil and gas have been noted in the porous dolomites and sandstones of Ordovician and Cambrian age in southwestern Ohio, but no commercial quantities of oil or gas have been found.

CALIFORNIA

(Continued from page 173)
the California oil producing counties map.

About ⅓ of a mile north of Atlantic's new well, C. D. Howe was drilling below 1,299 ft.

Steam Well Lures Barnes

Barnes Core Drilling Co. has a unique solution to the drilling doldrums presently afflicting the industry. The Bakersfield contractor has a contract with Thermal Power Co., San Francisco, to drill up 30 steam wells north of Santa Rosa, Sonoma County. The 600 to 1,500 wells will be used to tap steam in the vicinity of hot springs for eventual use in electric generation.

CANADA

ALBERTA

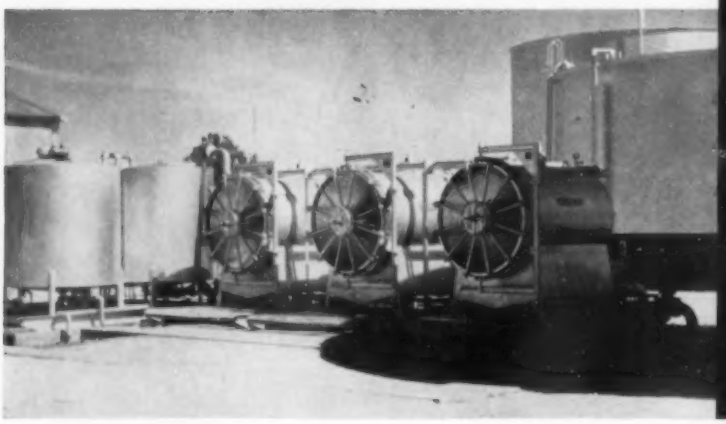
Joffre Area Extended

The British American Oil Co., Ltd. has completed a well in the Joffre area of central Alberta with an initial potential of 295 bbl. per day. This new success extends the possible limits of this Viking sand producing area another mile as another previous oil discovery (also drilled by the British American Oil Co.), 3 miles southeast of the main sector of the field lies only 1 mile northwest of this new success.

The well, British American 11 Kiendl, was drilled on LSD 11, 33-37-24w4, to a total depth of 4,680 ft and production casing was set at that depth. A 5-ft. interval was then perforated below 4,629 ft. and fractured. The flow rate of 295 bbl. per day was through a 20/64-in. choke and gas-oil ratio measured 385 cu. ft. per barrel.

The significance of these southeast step-out successes to the Joffre field has not been realized as yet because there has been no follow-up drilling between them and the southeast tip of the field. This same area, however, was recently enhanced further as Imperial Oil, Ltd., discovered oil in the

How to Keep
a Flood from
CHOKING TO DEATH



Identified as major causes of formation plugging are two microscopic miscreants—certain algae and several bacteria, particularly the sulfate-reducing bacteria. Counting on conventional treatment to remove these troublemakers is something like trying to trap mosquitoes with a picket fence ...most of them go right through and multiply mightily in the pores of the formation.

Diatomite filtration practically ends that threat by removing all algae and nearly all bacteria. That's the principal reason why many progressive operators today are filtering flood water with diatomite filter-aids such as Dicalite. Other advantageous features of diatomite filtration are the smaller space requirements, the lower capital investment and, most important, the complete salvability of a diatomite system.

An excellent example is this completely unitized diatomite filter system on a flood in West Texas. Three "Auto-Jet" filters, made by U.S. Filter Company, provide 1,500 ft² of filter area. 30,000 bbl/day of flood water go through this system; Dicalite Speedplus is being used as the filteraid. All units, including the precoat and slurry feeder tanks on the left, are skid-mounted for easy hauling.

For further information on Dicalite filtration of oilfield waters, write:

Dependable GLC GREAT LAKES Dicalite® DIATOMACEOUS MATERIALS

DICALITE DEPARTMENT, Great Lakes Carbon Corporation, 612 South Flower St., Los Angeles 17, Calif.

basal Quartz and D2 zone of Devonian at a field development test some 17 miles northwest of the recent completion.

The actual Joffre field stretches for 18 miles in a pencil-like line (only 1½ miles wide in its thickest section) in a northwesterly-southeasterly direction at the present time. However, this could be extended both northwest and southeast as the Bentley oil field, also a Viking sand structure, lies 7 miles northwest of the northwestern tip of the field while the recent successes southeast are 3 miles away. However, this theory has yet to be proved with additional drilling between in both cases.

ILLINOIS BASIN

Aux Vases Discovery Tested in Hamilton

Keystone Oil Co. has an indicated Aux Vases oil discovery in Hamilton County, 3 miles west of Walpole, Ill.

The 1 Burnett Unit, NEc 1-7s-5e, recovered 2,300 ft. of clean oil on a drill-stem test at 3,178-88 ft.

This pool-opener is located ¾ mile south of a flowing Aux Vases discovery made a few weeks back at C. E. Brehm 1 Ohio "A" in NE SW NE 36-6s-5e. That well made 400 bbl. per day from 3,200-30 ft.

LOUISIANA

SOUTH LOUISIANA

Little Temple Field Gets Second Oil-Producing Pay

Completion by Humble Oil & Refining Co. of its 2-B Alton Jones and others at Little Temple, on the Lafourche-Jefferson parish line, between Little Lake and Delta Farms, gives the field its fifth oil producer and second oil-productive sand.

These wells are exclusive of a potential gas-condensate well in another sand which has been standing ungaged and unproduced since completion.

The new oil well, in Lafourche Parish, is perforated at 10,870-86 ft. after drilling and running casing to 11,050 ft. Its production was gaged at 219 bbl. of 34.5°-gravity oil per day through ⅛-in. choke. Flow was with gas-oil ratio of 863 cu. ft. per barrel, and pressure of 1,850 psi.

Location of the well is on the south edge of the field. Humble's field-discovery well, completed in March 1955, was oil-productive from perforations at 10,669-79 ft. Its potential gas-condensate well, second test and west offset to the discovery well, is in another sand,

perforated at 10,768-76 ft. The other three oil wells produce from the discovery well's pay. Four dry holes have been drilled.

The area is about 20 miles south of New Orleans

MICHIGAN

Overisel Adds Well No. 23

The twenty-third Salina gas producer and the third failure in this objective were added in the Overisel gas pool, Overisel Township, Allegan County, by The Taggart Co., discoverer and developer of this first major gas pool in southwestern Michigan.

The most recent gas completion was in the C SE 15-4n-14w, which expanded the width of the pool, east and west to 2 miles at this point.

The third failure, which appeared to establish the west-southwest edge of the pool, was drilled in the C SW 21-4n-14w, the direct west 160-acre offset to a producible gas well completion.

Previously two Salina gas test failures were completed in the C SE and C SW 34-4n-14w, which is believed to have outline the south-southeast side of the field.

Three other gas tests are being drilled in the pool, drilling is scheduled to be started immediately at three other locations and drilling permits were issued for a half dozen new starts in the field this week.

It is expected that Taggart Co. will completely develop this Overisel gas pool, establish the limits of the field on all sides and sell the pool, without producing and selling a cubic foot of gas from it, for gas storage reservoir purposes.

MISSISSIPPI

Jefferson County Gets New Tuscaloosa Field

A lower Tuscaloosa stringer sand is proving productive in a wildcat drilled by Humble Oil & Refining Co in northern Jefferson County, in the southwestern part of the state.

The well, 1 Dockery and others, in 40-10n-2e, is being completed on the pump making 30 to 35 bbl. of 36.7°-gravity oil per day Potential gage was taken with well pumping against ¼-in. choke.

The well's pay is perforated at 9,816-22 ft. with hole plugged back from drilled depth of 12,250 ft. in the Lower Cretaceous section.

This is Mississippi's second Tuscaloosa discovery this year. It has been named "Red Lick" field after a small town, 2½ miles south.

NEW MEXICO

New Mexico Field Trip Announced for Autumn

The New Mexico Geological Society will hold its Eighth Annual Field Conference in the Durango-Silverton-Ouray area of southwestern Colorado on September 5, 6, and 7. For information write Mrs. Marion Burks, Box 652, Socorro, New Mexico.

SAN JUAN BASIN

Bisti Fires up With New Activity Reported

The Basti-Gallup trend in the San Juan basin is picking up considerable speed. Eight new wells were announced last week for this San Juan County area. Shell Oil Co. will put down five, Magnolia Petroleum Co. and Southern Union Gas Co. the others. Shell is one of the big developers for a reported big push into the general Bisti area this year.

Discovery . . . Sunray Mid-Continent Oil Co. opened a new Gallup sand gas

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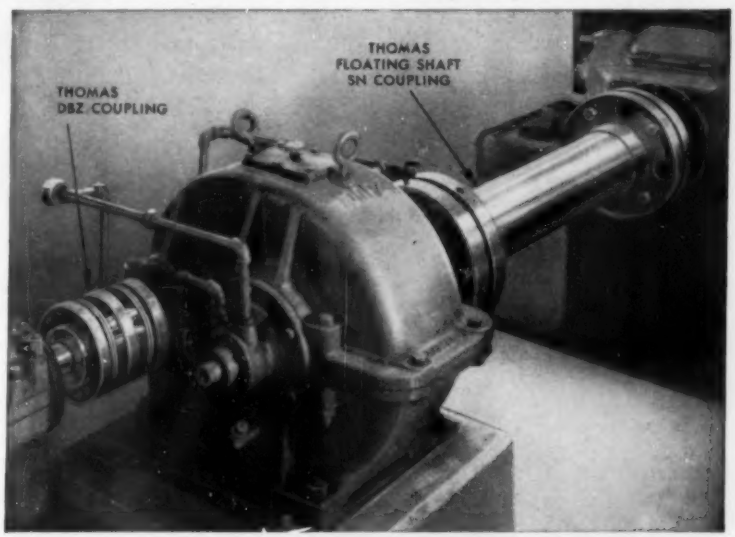

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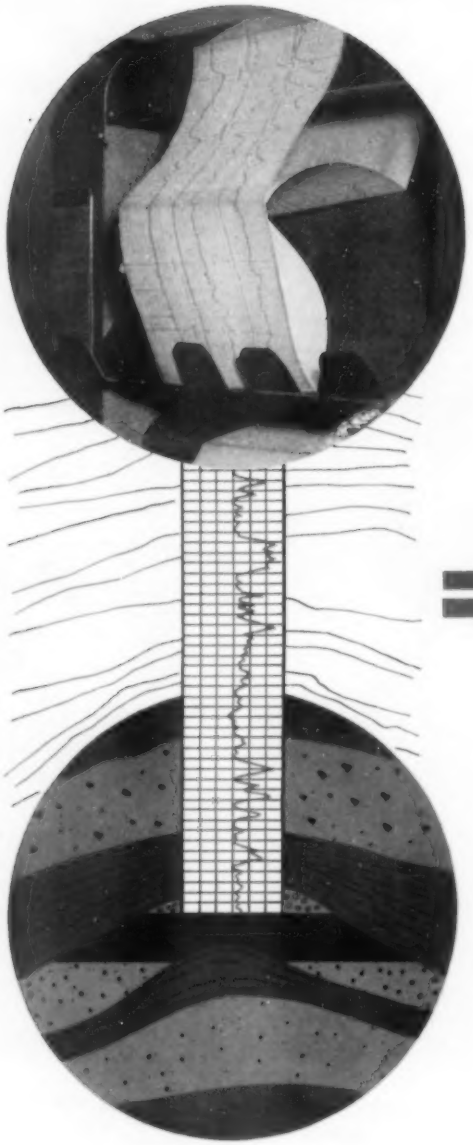
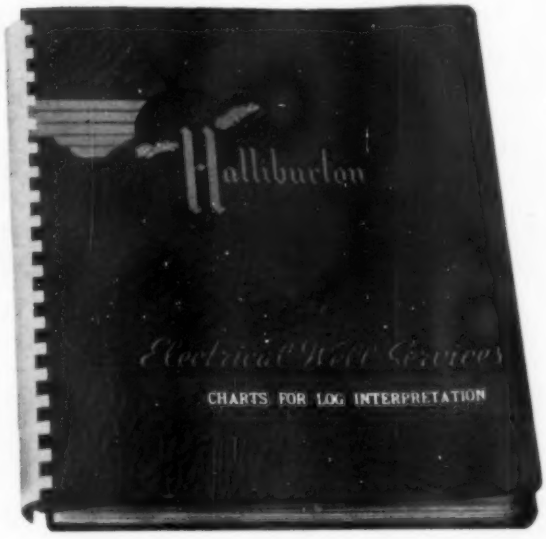


The importance to you of LOG INTERPRETATION



Accurate interpretation is half of a logging job. Without it, the information you seek about your subsurface property is lacking or misleading. With it, a properly run and interpreted log can be used as a "go, no-go gauge" for commercial producibility.

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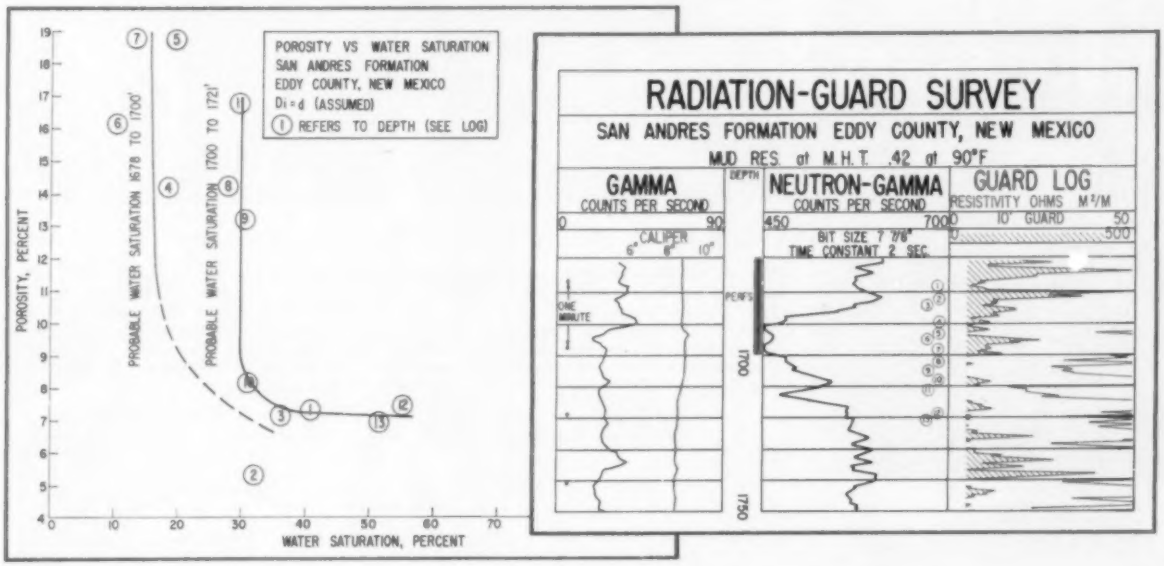
OIL WELL CEMENTING COMPANY, DUNCAN, OKLAHOMA

...how Radiation-Guard log evaluation of Eddy County carbonate formation

DETECTED PAY INTERVAL IN PUZZLING TRANSITIONAL ZONE

In this well in the San Andres formation in Eddy County, New Mexico, the difficult problem of evaluating carbonate reservoirs, which often vary widely in porosity, pore sizes, and pore size distributions, was successfully solved by the combination of Halliburton Radiation-Guard Log accuracy and a special Halliburton-pioneered interpretation technique.*



Analysis of the log curves yielded the data points on the graph. The points suggested the two porosity-versus-water saturation curves, indicating that in this well:

1. Water saturation for a given porosity increases with depth.
2. The entire interval may be within an oil-water transitional zone. (Such zones are often exceptionally thick in carbonate formations, and tend to misguide log evaluation.)
3. Best chance for relatively water-free oil production is in the interval 1688′ to 1700′.

The well was perforated from 1668′ to 1700′ and produced 28 barrels of oil plus 4 barrels of water per day.

---

* This log was analyzed by the method outlined in the recent Halliburton publication, "The Application of the Radiation-Guard Surveys to the West Texas, New Mexico Province." In addition to providing an intelligent guide to completions, this method leads to an economic evaluation of the producing zone through calculations of average porosity and maximum barrels of hydrocarbons in place.

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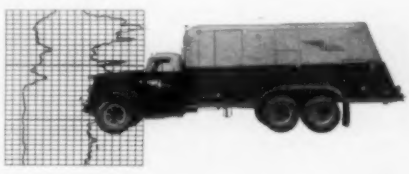

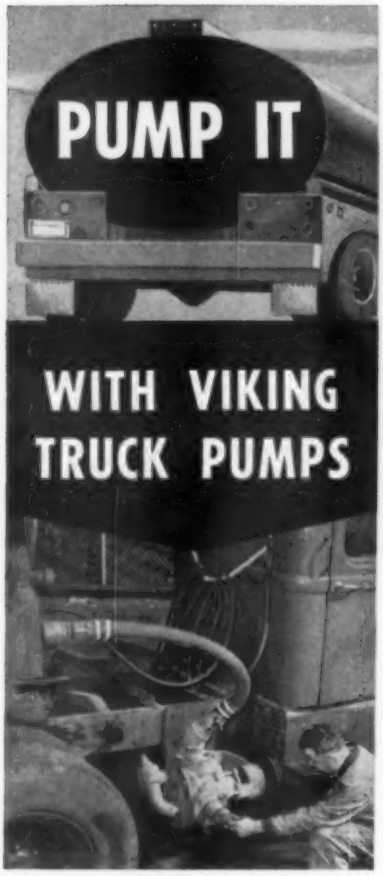

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Geophysical Society of Tulsa Rewards Students

William Erdahl (far right), president of the Geophysical Society of Tulsa and chief geophysicist of Skelly Oil Co., presents student awards to two members of the University of Tulsa Student Geophysical Society. Each year the Tulsa society honors two students in an effort to encourage the study of geophysics at the university. Recipients this year were: Robert Bingham, second from left, and Roger Sherburne, second from right. The society also presented Dr. H. M. Zenor, (left) head of the Geophysics Department at the university with a check for $75 for the purchase of books for the department.

field at 2 Es-Ka-Nel-E-Wood in C SW SE 22-25n-11w, San Juan County.

The well made 7,400 M.c.f. of gas per day from perforations in the Gallup sand at 4,923-60 ft. This is the second Gallup gas discovery in the trend.

SOUTHEAST NEW MEXICO

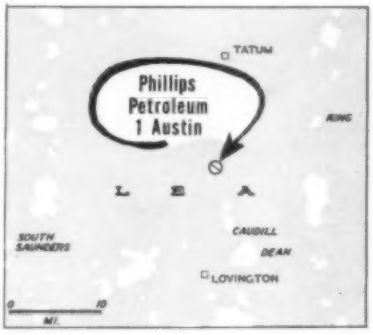
Lea County Wildcat Testing In the Mississippian

Phillips Petroleum Co. is continuing tests at its 1 Austin in northern Lea County, in an effort to make a gas or gas-distillate well out of it. Total depth was 14,796 ft., apparently in the Devonian. Extensive tests have also been made in the Pennsylvanian.

At the last report, plugged-back depth was 13,290 ft. Perforations at 13,270-86 ft. flowed 3 bbl. of load oil, 17 bbl. of 49° oil in 11 hours, and gas at the rate of 898,000 cu. ft. a day. The flow was through ½-in. choke. Previous drill-stem tests indicate a possible Mississippian oil-bearing section of around 100 ft. Location is in 17-14s-36e.

New Devonian Producer At Bell Lake

Continental Oil Co. has completed another Devonian gas well in the Bell Lake area of southern Lea County.



Phillips 1 Austin is a prospective Mississippian discovery. Location is 4½ miles northwest of Caudill field, in 17-14s-36e.

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No. 4 Bell Lake is approximately 1 mile south of similar production in the field, but separated by 3 Bell Lake, which was a Bone Spring discovery. No. 4 is located in the SE NW 6-24s-34e.

Continental drilled its 4 Bell Lake Unit to 15,566 ft., total depth. Top of the Devonian was picked at 14,733 ft. on elevation of 3,627 ft., and perforations were at 14,736-14,958 ft. Completion potential was at the rate of 64,000 M.c.f. of gas a day. Choke size, if any, and pressures were not reported.

OKLAHOMA

SOUTHWEST

Third Bromide Pay Found at Krieger Well

The deep Ordovician campaign at Knox in Grady-Stephens counties continues to top Sooner exploration and development happenings. The newest addition is British-American Oil Producing Co.'s 1 Krieger in C SW SW 3-2n-5w, over the county line from Grady into Stephens. The well flowed 5,800 M.c.f. of gas per day on drill-stem test at 15,123-15,297 ft. Average flow was 5,700 M.c.f. with 13.8 bbl. of distillate in 20 minutes, or 34 bbl. in 1 hour.

Third Bromide pay at this well gives it three indicated commercial zones—the Viola and second Bromide being the other two.

● Buffalo Oil Co. will drill a 16,000-ft. Ordovician hole in this deep area, becoming the tenth well below 15,000 ft. The 1 E. E. Harrison is located in NE SW NE 30-3n-5w, Grady County.

The third Bromide sand is the deep interval producing at the 2 Harrison well, the state's deepest producer, also in this field. Log indicated 80 ft. of porosity at the Krieger well compared with Harrison's 65 ft. Zones tested at this well are: the Viola at 13,850-13,965, the second Bromide at 14,807-14,918, and the third Bromide at 15,123-15,297 ft.

NORTHERN

Another Cherokee Sand Discovery in Grant County

The Cherokee sand of Pennsylvanian age continues to add new gas and distillate production to the growing trend along northern Oklahoma's Grant-Alfalfa counties area.

The new discovery is Davon Drilling Co. and Anderson-Prichard Oil Corp. et al 1 Johnson in C NE SW 18-27n-8w, Grant County. The well flowed an estimated 12,000 M.c.f. of gas per day from perforations at 5,255-94 ft. Logs show about 60 ft. of sand at this pay zone.

Southeast Stockholm Is Northwest's Busiest Area

The most active exploratory and development area in northwestern Oklahoma is new Southeast Stockholm field in Harper County. Field development spreads through four sections of 26n-23w.

Here is the rundown on current activity:

... Pure Oil Co. just completed 1 A. R. Palmer in NE NE 29 for 503 bbl. of oil per day on 30/64-in. choke from perforations in the Pennsylvanian-Tonkawa sand at 5,502-08 ft.

... Pure is drilling below 2,415 ft. at 2 Palmer in C NW NE 29.

... Eason Oil Co., the area's busiest operator, is drilling at 2,861 ft. at 1 Campbell in C SE NW 21.

... Production tests are due at Eason 1 Palmer in C NW NE 28.

... Eason is reperforating at 1 Palmer in C SW NE 21.

... Reperforation is under way at the 1 Waldo Garnett in the Chester-Mississippian. This well is in C NE SE 28.

(Continued on page 186)

When the pumping is rough a **JENSEN** gets tough!

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CRETACEOUS	Montana	Kirtland (Farmington)	➧	Aztec ☼ Blanco ☼ Bloomfield ● Wyper ☼	
		Fruitland	➧	Aztec ☼ Cottonwood (Rosa) ☼ Gallegos ☼ Gomez ☼ South Ignacio ☼ West Kutz Canyon ☼ La Jara ☼ Los Pinos ☼ Allison ☼ Bondad ☼ Ignacio ☼	
		Pictured Cliffs	➧	Blanco ☼ Gavilan ☼ Kutz Canyon ☼ Fulcher Basin ☼ Rosa ☼ Ignacio ☼	
	Mesaverde Group	Cliff House Menefee Point Lookout	➧	Blanco ☼ Hospah ● Kutz Canyon ☼ Fulcher Basin ☼ La Plata ☼ Red Mountain ● Seven Lakes ☼ Stoney Butte ● Bondad ☼ Blanco ☼ Ignacio ☼ Red Mesa ☼ Barker Dome ☼	
		Gallup		Bisti Trend ●	
	Colorado	Mancos (Tocito)	➧	Chaco Canyon ☼ Chromo ☼ Pettigrew ☼ Mancos Creek ☼ Red Mesa ☼ Doswell ☼	
		Dakota	➧	Angels Peak ● Barker Creek ☼ Hogback ● Lindrith ● Price Rattlesnake ☼ Table Mesa ● Ute Dome Asbury Creek ☼ Bar X Blanco ☼ Gramps ☼ Phillips ☼ Point Lookout ☼ Red Mesa ☼	
JURASSIC		Morrison	➧	Price ☼ Ignacio ☼	
		Entrada	➧	Torreon ●	
TRIASSIC		Shinarump	➧	McElmo ☼	
NO PERMIAN PRODUCTION					
PENNSYLVANIAN	Virgil	Rico	➧		
	Missouri	Hermosa — Upper Hermosa (Bluff)	➧		Boundary Butte fields ☼ Aneth ● Bita Peak ☼ Recapture Creek ● Bluff ● East Aneth ● South Ute Mountain ☼ North Desert Creek ●
	Des Moines	Hermosa — Paradox (Desert Creek)	➧	Barker Creek ☼ Rattlesnake ● Ute Dome ☼	Desert Creek fields ● Bluff ● Aneth ● Dove Creek ● Four Corners ●
	Atoka Morrow		➧		
MISSISSIPPIAN	Meramec Osage	Leadville	➧	Rattlesnake ● Tocito Dome ☼	
DEVONIAN	Upper	Ouray	➧	Rattlesnake ● Tocito Dome ☼	

OKLAHOMA

(Continued from page 183)

. . . W. O. Allen 1 USA in C NE SE 29 is shut down with total depth of 3,810 ft.

. . . A Fort Worth outfit, Midwest Oil Corp., located a well on the northeast flank of the pool at 1 Palmer in C NW NW 12.

The field has four producing oil wells and one gas-distillate. All produce from the Pennsylvanian sands. This area is east of the Laverne district which made oil and gas headlines in northwestern Oklahoma last year and continues to develop briskly.

ROCKY MOUNTAIN

UTAH

Prolific Paradox Oil Discovery by Carter

Carter Oil Co. completed a big Paradox-Pennsylvanian discovery well in San Juan County. The 1 Navajo-114, SW NW NW 8-41s-25e, flowed 2,330 bbl. per day from perforations in the Paradox at 5,546-96 ft. Flow was on ¾-in. choke.

Carter followed up with location for an offset at 2 Navajo-114 in SW NW SW 8-41s-25e, just south of the discovery well. The new discovery moves the Aneth area to the southeast. The new field is 3½ miles northeast of "East Desert Creek" field. It opens first production in Township 41 South.

COLORADO

Paradox Gas Discovery Completed in La Plata

A new gas field was opened in La Plata County in southwestern Colorado's Red Mesa area. General Petroleum Corp. completed its F-11-32 Cater in C NW NW 32-34n-12w, for a flow of 15,780 M.c.f. per day on 48/64-in. choke. Perforations are in the lower Paradox at 9,420-9,500 ft., considerably deeper than in the Paradox basin oil play area.

The Cater discovery is 5 miles northwest of Red Mesa, a Cretaceous gas-producing field.

TEXAS

TEXAS GULF COAST

Extension Gas Discovery Reopens Farwell Area

The Farwell area at the eastern end of Espiritu Santo Bay, eastern arm of San Antonio Bay, in Calhoun County, has been given another boost with a wildcat gas-discovery by Brazos Oil & Gas Corp.

LOCATION of Brazos Oil & Gas Corp.'s new gas-discovery well in Farwell area, at east end of Espiritu Santo Bay, Calhoun County, Texas.

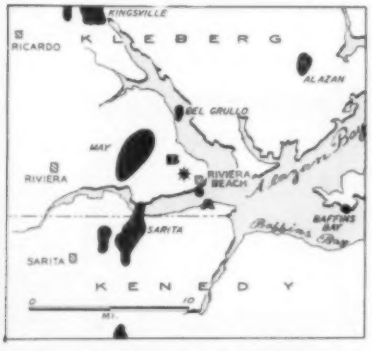
Brazos' discovery well is in Tract 215, 7 miles southwest of Port O'Connor, on the mainland. It produced at the rate of 2,000,000 cu. ft. of gas per day when tested through 7/32-in. choke. Pressure was 1,775 psi. Its pay is perforated at 4,326-34 ft. Total depth is 6,302 ft.

Location is about 1½ miles southwest of a lone gas well completed by Humble Oil & Refining Co. at the west end of the small Farwell Island in 1951. Humble's well, 1 State, in Tract 227, is perforated at 4,240-50 ft.

The new well is Brazos' second attempt in the area. Its first test, less than ½ mile north in Tract 216, blew out and was abandoned at 6,160 ft.

Oil Production Opened In Riviera Beach Area

The Riviera Beach area, in southern Kleberg County, proved oil-productive last week in a Frio-sand discovery by



RIVIERA BEACH area on Baffins Bay, in southern Kleberg County, showing Sun Oil Co.'s oil-discovery well (A), and Arkansas Fuel Oil Corp.'s gas-condensate discovery (B).

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Sun Oil Co. at its 373-1 State, a wildcat in Baffins Bay, south of the resort beach.

This discovery is about 1½ miles southeast of a gas-condensate discovery by Arkansas Fuel Oil Corp. last month in its 1 Reitsch, a wildcat on shore west of the beach resort.

The area, 7½ to 8 miles east of the town of Riviera, is about 3½ to 4 miles southeast of the fast developing, multiple-pay May oil and gas field opened by Arkansas Fuel in 1955.

Sun's well flowed 129.29 bbl. of oil per day through 13/64-in. choke. Its gas-oil ratio measured 395 cu. ft. per barrel. Flowing pressure was 120 to 300 psi. It is perforated in a 8,050-ft. sand after drilling to 9,651 ft. Production of Arkansas Fuel's gas-condensate well is from a 6,650-ft. sand.

Nearest other oil production is in Sarita field, which straddles the Kleberg-Kenedy county line several miles southwest.

Goliad County Wildcat Opens New Wilcox Pool

Harkins & Co. and W. Carlton Weaver have a Luling (Wilcox) sand oil-discovery well in northern Goliad County.

It is their 1 Schroeter, in the Jose Maria Mancha Survey, 5 miles west of Weesache. Location is about a mile southeast of Slick-Wilcox field, and between that field and Gottschalt-Wilcox field, about 2 miles farther southeast.

Pay-zone is perforated at 7,631-34 ft. in hole drilled to 8,015 ft. Potential gage has not been reported, but the well flowed clean oil under pressure of 570 psi. while cleaning through 11/64-in. choke.

A drill-stem test recovered 375 ft. of clean oil with 600 ft. of oil-cut mud, and 15 ft. of mud. Recovery was through ¼-in. chokes, pressure (flowing) 460-565 psi.

EAST TEXAS

Oil Shows Reported in Anderson Woodbine Test

Bracken Oil Co. 1 Amelia Hassell Petty, a 6,000-ft. Woodbine wildcat in southeastern Anderson County, found oil and gas shows on a drill-stem test of Woodbine sand.

Operators reported top of the sand at 4,716 ft., on elevation of 354 ft. A 20-minute test at 4,720-23 ft. recovered 90 ft. of gas-cut mud and 60 ft. of oil-cut mud. It was cored ahead after the test. Location is in the Richard Duty Survey, 10 miles east of Palestine and about 7 miles northeast of the Slocum fields.

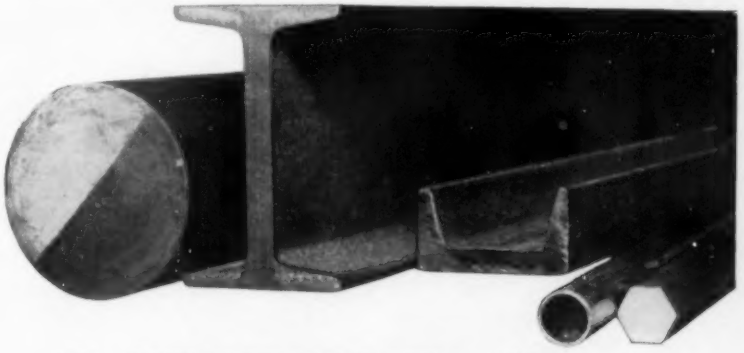
Marion County . . . A 9,300-ft. Cotton Valley wildcat has been started in northwestern Marion County, 14 miles northwest of Jefferson townsite. The project is a joint operation by Great Expectation Oil Corp. and Amerada Petroleum Corp., drilled as 1 Segal.

Location is on a 100-acre lease in the James Wimberly Survey, A-383. The two companies hold a block of 4,500 acres in the area. Subsurface control is furnished by two shallow tests drilled on the acreage last year, and the discovery well of Lassater field, 4 miles to the northwest. This well was originally completed as a Rodessa discovery, and later recompleted as a Travis Peak gas well. Total depth was 10,514 ft., with top of the Cotton Valley at 9,100 ft.

TEXAS PANHANDLE

Missouri Discovery Completed in Ochiltree

Ochiltree County has a new Missouri-Pennsylvanian oil pool. M. A. Machris of Midland completed 11-147 Harbaugh as a new-pay discovery in Harbaugh field, 22 miles south of Perryton in the southwestern part of Ochiltree County. The well, location in Section 147, Block 13, T&NO Sur-



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vey, for 78 bbl. per day on pump. Perforations are at 6,996-7,006 ft.

NORTH TEXAS

Jones County Wildcat Makes Ellenburger Pumper

Jocelyn-Varm Drilling Co. and Jack F. Grimm 1 W. E. Smith, 6 miles north of Trent in south-central Jones County, has been completed as an Ellenburger discovery.

Completion potential, on the pump, was 86 bbl. of 42° oil a day, with no water, from perforations at 5,471-79 ft. Gas-oil ratio was 200:1. Location is in Section 26, Block 19, T&P Survey.

New pay in Taylor field . . . S. C. Herring Drilling Co. 2 Eula Alexander, located in the Ulander (Cross Cut) field, 4 miles west of Ovalo, has been completed as a flowing discovery from the Gray sand. Nearest Gray sand production is 1½ miles to the southwest in Proctor field.

Flowing potential was 218 bbl. of 45° oil in 17 hours, through 14/64-in. choke, from perforations at 4,610-16 ft. Total depth was 4,650 ft. Location is in H. Plummer Survey 530. Ovalo field is in south-central Taylor County.

New Palo Pinto prospector . . . Gro-Part Oil Co., Dallas, has scheduled an Ellenburger wildcat 7 miles northwest of Graford in Palo Pinto County. Location on a 40-acre lease in Martha Stevenson Survey is on the east edge of the north end of Possum Kingdom Lake. Contract depth is 4,900 ft. Drill site is about 1 mile northwest of shallow production.

Successful Wildcats

TEXAS GULF COAST

Bee County: Skelly Oil Co. 1 Muckelroy, John Van Bibber Sur., A-582. IP 8,700 M.c.f. daily, open flow, GLR 40.7 M.c.f. per bbl., 53.8°, shut-in tubing pressure 4,338 psi., perfs. 8,346-60 ft. (Wilcox-Luling sand). TD 9,666 ft. (Extends Wilcox production in Normanna area.)

A. A. Moore et al 1 Wallek, A. Dickinson Sur., A-159. Shut-in gas well, no gage, perforations 3,547-53 ft. (Frio). TD 3,709 ft. (New pay and extension in unnamed field—second well.)

Coastal Trend Oil & Gas Corp. 1 Cyrus Fox, Michael Fox Sur., A-24. IP 70,000 M.c.f. daily, open flow, dry gas, shut-in tubing pressure 1,651 psi., perforations 3,783-86 ft. (Vicksburg). TD 5,509 ft. (New field.)

Calhoun County: Tidewater Oil Co. 1 State Tract 139, San Antonio Bay. IP 3,100 M.c.f. daily and ungaged volume of condensate, 5/32-in., TP 5,300 psi., perforations 9,020-51 ft. (Frio). TD 11,000 ft. (New field.)

Jackson County: Texkan Oil Co. 1 Williamson, Section 21, Pickering Ranch Subd., P. Scott Sur., A-69. IP 52,000 M.c.f. daily, open flow, GLR 446.8 M.c.f. per bbl., 50.5°, shut-in tubing pressure 2,057 psi., perforations 5,683-93 ft. (Frio). TD 6,814 ft. (New pay in North LaWard field.)

SOUTHWEST TEXAS

Karnes County: Gulf Oil Corp. (Christi, Mitchell & Mitchell et al) 1 Laskowski, J. W. Clifton Sur., A-68 (3 miles north of Fashing). IP 24,500 M.c.f. daily, open flow, GLR 42 M.c.f. per bbl., 52.6°, perforations 10,794-10,832 ft. (Edwards lime). TD 11,327 ft. in Glen Rose. Elev. 487 ft. Edwards 10,670 ft. (New Edwards field.)

McMullen County: Murphy Corp. 9-C. Ezzell, Section 54, Hays-Ezzell Subd., W. D. Hodges Sur., A-964. IP 60.23 BOPD, 5/32-in., 39.5°, GOR 200 cu. ft. per bbl., perforations 5,039-42 ft. (Queen City "B" sand). TD 5,100 ft. (New pay in Clayton field.)

WEST CENTRAL TEXAS

J. E. Connally 1-A Hewes, Lavaca CSL Sur. 6, 7 mi. N Cross Plains. IP 37 BOPD, 23/64-in., 40°, GOR 550, TP 200 psi., reef pay 2,925 ft. TD 2,956 ft.

Parker County: Toto Gas Co. 1 A. Roberts, Sec. 127, T&P Sur., 13 mi. N Weatherford. IP 624 M.c.f. gas, CP 80 psi., Caddo perforations 3,760-68 ft. TD 5,616 ft.

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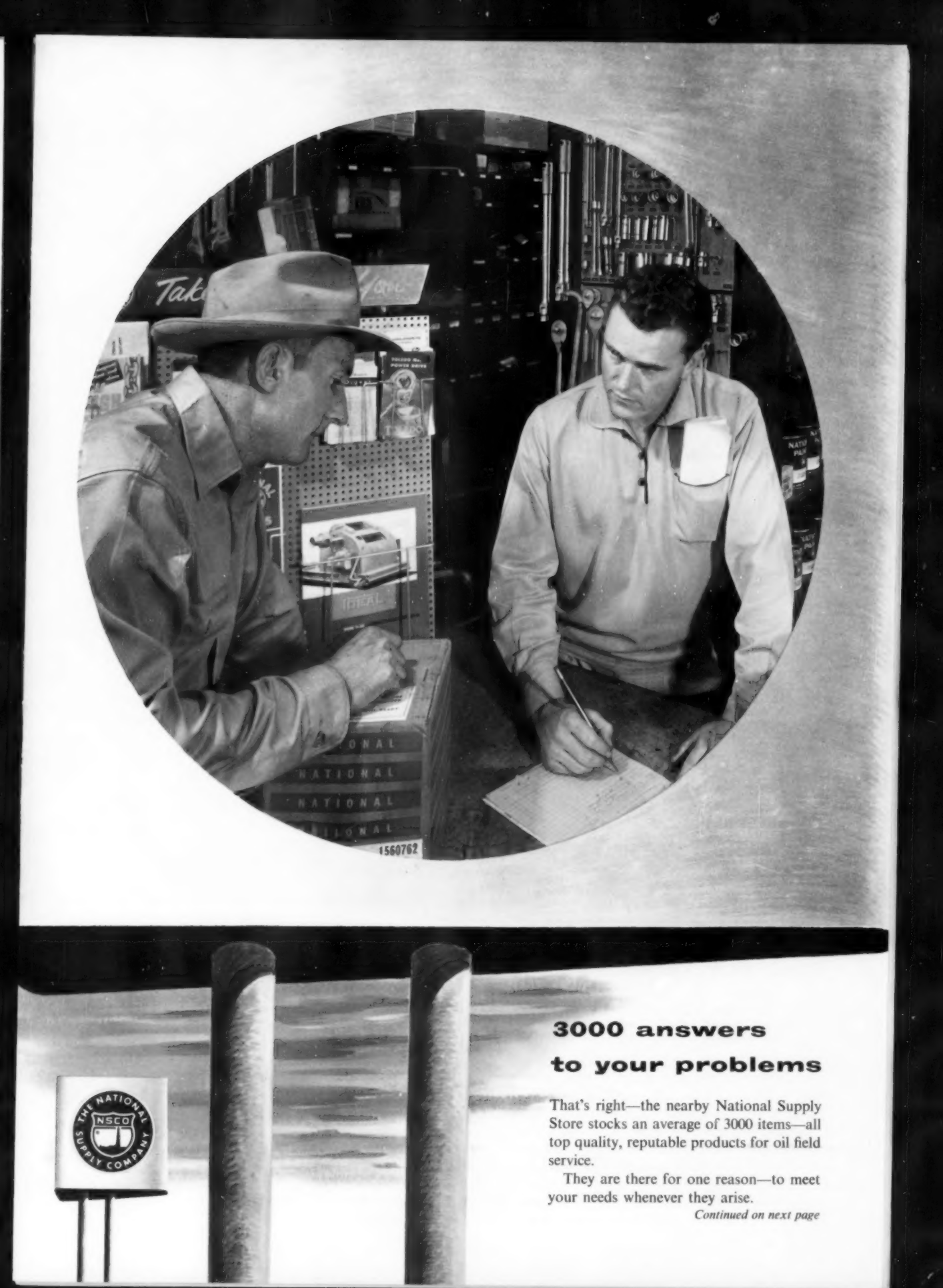

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Continued on next page

Continued from preceding page

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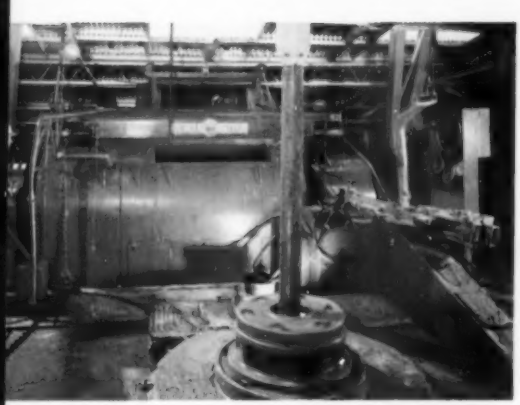
Safe table guard—With a wide, non-skid tread top of original National design. Removable guard extends above table top, deflects all mud.

Improved pinion shaft assembly—For easy servicing, entire assembly is mounted in individual housing on the under side of the base.

Special mud and oil seals—Prevent entrance of mud or escape of oil between table and base. Other special labyrinths prevent entrance of mud into bearing.

Oil bath lubrication—A continuous action system, induced by table rotation, insures ample lubrication for all bearings and gears.

These features, plus the confidence of contractors everywhere, are good reasons why you buy wisely when you choose a National Rotary. You'll operate more efficiently with a National Rig behind it, too!



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...and reduce

drill pipe failures with

precision National Kellys

and Drill Collars

Here's why National Kellys and Collars promote maximum penetration rates at all drilling speeds and help reduce drill pipe failures:

NATIONAL KELLYS, in both square and hexagonal types, are precision-manufactured of Ideal Electric Steel and accurately bored for true concentricity. In use, they provide smoother "feed-off" and the true balance necessary for long drill string life and trouble-free operation.

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In operation with this National Kelly is the SA-175, first of a new line of National Rotaries. It features a rectangular design for easy installation, a cartridge-type pinion shaft assembly, and a unitized table and bearing assembly.

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NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

E. L. STEINIGER, Sinclair's executive vice president, operations.

Steiniger Helps Run Top Team

TEN YEARS AGO, Edward L. Steiniger was in Venezuela, working with Venezuelan Petroleum Co., a subsidiary of Sinclair Oil Corp. Today he's in New York with the parent company as executive vice president-operations. It is a remarkable bit of progress for a rather remarkable guy.

It is almost as remarkable as his entry into the oil business.

Steiniger attended Pace College and New York University, majoring in business administration. His first job was in the cost accounting department of Consolidated Steel. Then he went with Price Waterhouse & Co., the widely known accounting firm. There he did pretty much the same sort of thing he had been doing with Consolidated.

One of his assignments with Price Waterhouse was to help revise the accounting system for Farmers' Loan & Trust Co. He was on this job when a friend at Sinclair told him that Sinclair was a good place to work.

Steiniger took the tip, applied for a job and got one—in the exploration department. A switch from cost accounting to oil exploration is about as pronounced as a switch can be. That was in 1925. He worked at the company's headquarters until 1928 when he went to Venezuela. Steiniger spent most of the next 25 years in Venezuela.

Venezuela: yesterday, today . . . Steiniger came close 25 years ago to helping find a field that is making big news today.

One of the first wells Sinclair drilled in Venezuela shortly after Steiniger's arrival was near the town of Barinas. But this test was abandoned because the tools were not heavy enough to reach the objective. Had they been, this test might have opened what is now Barinas field, one of Venezuela's exploration hot spots.

Sinclair discovered oil in Barinas in 1953, almost a quarter of a century after its initial exploratory well was drilled. Venezuelan Petroleum, 96.24 per cent owned by Sinclair, has 600,000 acres under lease in Barinas.

Since that time 33 wells have been drilled. Twenty-five are producers. Three strings are in use and, by this fall, some 30 to 35 producing wells will probably be completed. The producing wells are shut in, awaiting completion of a pipeline to the Caribbean.

The line is due for completion in the latter part of this year. It is a 212-mile, 20-in. line and will have an initial capacity of 100,000 bbl. per day. Upon its completion, Sinclair will add considerably to its Venezuelan production. The line is jointly owned with Socony Mobil.

Steiniger was in Venezuela when Sinclair discovered its first production in February 1941. This was the Santa Barbara field, in the eastern part of the country. Later discoveries were the Muri, Guere, and the recent very promising Aguasay field. All of Sinclair's Venezuelan production is obtained from these eastern Venezuelan fields.

Steiniger looks back with considerable satisfaction on the accomplishments of the company in Venezuela as setting the groundwork for a very encouraging prospect for future production.

As executive vice president of operations, Steiniger also keeps tab on Sinclair's other foreign work.

The company has 50 per cent interest in 56 million acres in Somalia. A recent dry hole in Somalia showed some favorable indications and more holes will be drilled.

Early this year, Sinclair gave up another area in a mutually agreeable deal with a sovereign. The sovereign's consent was necessary since the concession covered the entire country—Ethiopia.

Spotted long ago . . . The traits which eventually put Ed Steiniger into a very important position in the company apparently started to become evident about 20 years ago.

In 1936 he was elected a director of Venezuelan Petroleum. In 1938 he was made a vice president and in 1950 president. Five years later he was elected a vice president of the parent company. His field then was foreign operations. At the same time he was elected a director and a member of the executive committee.

Today he is a member of the senior management group. It is made up of P. C. Spencer, president; M. L. Gosney, chairman of the board; James E. Dyer, president of Sinclair Refining Co.; the other of the two executive vice presidents, Harry Jeffries, whose field is administration; and Steiniger.

Steiniger, 54, is a native New Yorker and a resident of Manhattan Island. He is a director of American Petroleum Institute and a member of the Pan-American Society and the Newcomen Society. He is also a member of the N.Y.U. club and the Shenorock Shore club of Rye, N. Y.

J. P. Schmalz, head of Tennessee Gas Transmission Co.'s Midland, Tex., district office, has been named division production superintendent in the new central division headquarters, which have been moved to Midland from Fort Worth. Schmalz succeeds **O. W. Ward,** who was recently named vice president of the Canadian division, production department. New production offices have been opened by the company in Odessa, Tex., and Hobbs, N. M. **D. P. Dampf,** operations assistant in Midland, has been appointed district superintendent in Hobbs, and **J. D. Hicks,** area superintendent in Monahans, Tex., will be Odessa district superintendent.

"Chief Roughneck" Honored at TIPRO Meeting

Arch Rowan, right, Fort Worth independent who entered the oil industry in 1919 as a roughneck, received the "Chief Roughneck of 1957" award at the recent meeting of Texas Independent Producers and Royalty Owners Association. R. E. (Bob) Smith, Houston independent, left, was last year's chief roughneck. The award is made annually to a former roughneck who has made outstanding contributions to the industry. It is sponsored by Lone Star Steel Co.

R. B. Haynie, geologist with Sahara Petroleum Co., has been transferred to Midland, Tex., by Continental Oil Co.

Norman C. Miller has been promoted by Delhi-Taylor Oil Corp. from district geologist in Oklahoma City to senior staff geologist in Dallas.

Talmage Lovelady, Pure Gas Service Co., Worland, Wyo., has been elected president of the Liquefied Petroleum Gas Association. Lovelady succeeds **K. H. Dickson,** Uregas Service, Inc., Moberly, Mo. Other officers are **A. E. Bone,** Eastern Propane Co., first vice president; **R. H. Wherry,** Service Gas Co., second vice president; and **A. H. Menuet,** Skelly Oil Co., treasurer.

Frank Searcy, Continental Oil Co., has been elected 1957 president of the Tulsa Geophysical Society. Other officers are **T. S. Green,** Geo Prospectors, Inc., first vice president; **Frank Kittredge,** Skelly Oil Co., second vice president; **Stanley Giulio,** Carter Oil Co., secretary; **Perry McNally,** Phillips Petroleum Co., treasurer; and **M. B. Widess,** Pan American Petroleum Corp., editor. District representatives are **L. Y. Faust,** Amerada Petroleum Corp.; **T. S. Born,** Geophysical Research Corp.; **John Crawford,** Continental Oil Co.; and **W. M. Erdahl,** Skelly Oil Co. Erdahl is immediate past president of the group.

Robert P. Grigg, Jr., Tidewater Oil Co. geologist in Lafayette, La., has been transferred to New Orleans as geologist in charge of the area office there.

Bill Hudson has left Lion Oil Co. in Fort Morgan, Colo., to join Cabeen Exploration Corp. in Denver as district production superintendent.

D. D. Wright has been named superintendent of production operations for Royalite Oil Co., Ltd. A graduate of the University of Alberta, Wright has been with Royalite since 1942.

L. F. Adams has been appointed assistant to the general manager of The California Co.'s exploration-eastern region. Calco has set up three new exploration divisions in a reorganization of the eastern region. Appointments to these new divisions include **L. W. Funkhouser,** Southeast Louisiana division exploration superintendent, and **R. H. Wegener,** southeast division geophysicist. In the southwest division, **B. L. Shullaw** has been named division exploration superintendent with **A. F. Barker** as division geophysicist. In the offshore division, **J. J. Pennington** has been appointed exploration superintendent and **I. B. Murray** will be division geophysicist. **W. H. Akers** has been named senior paleontologist and will work with all three divisions.

Bert C. Aschenbrenner has been named research geologist for Atlantic Refining Co. at Casper, Wyo.

James Finley, Continental Oil Co.'s Midland, Tex., division manager, has been transferred to Houston as assistant to the geophysical manager.

Robert H. Walton has been promoted to senior mechanical engineer at Humble Oil & Refining Co.'s Baytown, Tex., refinery.

E. L. Fundingsland, Jr., geologist in Houston with Standard Oil Co. of Texas, has joined Skelly Oil Co. in Albuquerque in the same capacity.

Martin K. Hager, Panhandle Eastern Pipe Line Co.'s vice president in charge of operations and president of Century Refining Co., Panhandle subsidiary, has been elected a director of the parent company. Hager is also a director of Petro-Chemicals Corp., which Panhandle owns jointly with Chemical Corp. and National Distillers.

A. B. Brown, managing director of Caltex Pacific Petroleum Co., Indonesian affiliate of Standard Oil Co. of California for the past 2 years, has been named president of Richmond Exploration Co., Socal's South American producing and exploration subsidiary. His headquarters will be in Caracas, Venezuela. Brown succeeds **C. R. Cabrera,** who was recently appointed to Socal's executive staff. Brown has had several foreign assignments since he joined Standard of California in 1930. He has served in Saudi Arabia, Sumatra, Venezuela, Peru, and Colombia.

H. C. Hose, vice president for marketing with California Texas Oil Co., Ltd., has been elected executive vice

H. C. HOSE

H. B. NICHOLS

president of the company. He succeeds **A. J. Singleton,** who was recently elected Caltex president. **H. B. Nichols,** vice president in charge of refining, has been named senior vice president, and **G. R. Ferguson,** formerly assistant vice president, has been elected a vice president. **R. E. Ludt** has been named executive assistant to the chairman of the board.

H. H. BAKER

Hines H. Baker, who recently retired as president and a director of Humble Oil & Refining Co., has been elected a director of Standard Oil Co. (N. J.). Baker joined Humble in 1919. He was named head of Humble's refining and marketing operations in 1940, a vice president in 1941, executive vice president in 1945, and has been president and chief executive officer of the company since 1948. Baker succeeds **J. E. Crane** on the Jersey Standard board. Crane has retired after 22 years with the company.

Haygood Hendry has been appointed Midland, Tex., district exploration superintendent for Sohio Petroleum Co. Hendry was formerly assistant to the division landman.

Parke A. Dickey, head of geological research for Carter Oil Co., is newly elected president of the Tulsa Geological Society. Dickey succeeds **Ralph A. Brandt,** Atlantic Refining Co. Other officers of the society are **Augustus Goldstein,** Pan American Petroleum Corp., first vice president; **Norman S. Morrisey,** The Oil and Gas Journal, second vice president; **James W. Snider,** Amerada Petroleum Corp., secretary; **G. Wilbur Haynes,** Pan American Petroleum, treasurer; **Robert H. Arndt,** University of Tulsa, editor; and **S. E. Frezon,** U. S. Geological Survey, business manager. New council members are **Edmund T. Benson,** Service Pipe Line Co.; **Donald E. Hanson,** Sinclair Oil & Gas Co.; and **Donald L. Norling,** independent.

George L. Laurent, Standard Oil Co. of California, Western Operations, Inc., has been elected chairman of the Pacific Coast district of the American Petroleum Institute's Division of Production. Other officers are **C. R. Ball,** Ball & Black Supply Co., treasurer; **Don Hall,** McCullough Tool Co., assistant treasurer; **Mrs. Elsie M. Edmiston,** A.P.I., secretary; **Paul Andrews,** Signal Oil & Gas Co., chairman of the advisory committee; and **T. H. Acres,** Sunray Mid-Continent Oil Co., vice chairman of the advisory committee. Vice chairmen of the district are **Donald S. Hare,** Monterey Oil Co., Los Angeles Basin area; **Graham Lester,** Union Oil Co., coastal area; **H. M. Van Clief,** Honolulu Oil Corp., San Joaquin Valley; and **T. W. Patten,** Standard of California, Coalinga-Kettleman.

A. W. Farmilo, chief geologist of Calvan Consolidated Oil & Gas Co., Ltd., and Western Leaseholds, Ltd., has been promoted to management assistant.

Vernon Taylor, regional manager for Imperial Oil, Ltd., has been elected president of Alberta Gas Trunk Line Co. Directors elected at a recent stockholders meeting include **N. E. Tanner,** president of Trans-Canada Pipe Line Co., Ltd.; **A. G. Bailey,** vice president and general manager of Bailey Selburn Oil & Gas, Ltd.; **D. C. Jones,** superintendent of Hudson's Bay Oil & Gas, Ltd., and **B. F. Willson,** vice president of Canadian Western Natural Gas Co.. **R. J. Dinning,** chairman of the board of Burns Co., Ltd., and **George Church,** president of United Farmers of Alberta Co-operative, appointed directors earlier by the Alberta Government, will continue as board members.

G. D. (Dan) Almen, Jr., manager of Sinclair Oil & Gas Co.'s offshore division at New Orleans, and a vice president of the company, has been appointed manager of the Houston division. **R. A. Wright,** assistant to the president assigned to the offshore division, has been elected a vice president and will succeed Almen as offshore manager. Wright was assistant division manager in Denver before recently transferring to New Orleans. **Dick T. Fenwick,** executive assistant in the Tulsa production department, will transfer to Denver as assistant division manager replacing Wright. Almen and Wright are long-time Sinclair employes. Fenwick was with Southern Production Co. when it was purchased by Sinclair last year.

G. D. ALMEN, JR.

R. A. WRIGHT

H. D. Chrislip, Kerr-McGee Industries, Inc., has been elected 1957-58 president of the Pipe Liners Club of Tulsa. Also elected were **H. T. Chilton,** Service Pipe Line Co., vice president; **G. P. Jennings,** Phillips Petroleum Co., secretary; **W. E. Biery,** Mid-Continent Pipe Line Co., treasurer. Directors are **E. A. Slade,** Okan Pipe Line Co.; **J. R. Ellis,** Oklahoma-Mississippi River Products Line; **J. C. Phelps,** Continental Pipe Line Co.; and **I. B. Tietze,** Phillips Pipe Line Co.

Personals

T. A. Van Griethuysen, Continental Oil Co.'s vice president in charge of transportation and supplies in Houston, has been named president and a director of Continental Oil Co. of Venezuela and transferred to Caracas, Venezuela. **Charlton Kerr,** staff geophysicist for Conoco in Venezuela, has been elected vice president, exploration manager, and a director of the Venezuelan subsidiary. Van Griethuysen has been with Conoco since 1929. He was manager of crude-oil purchasing and sales before becoming coordinator of transportation and supplies in 1952 and a vice president the following year. Kerr joined the company in 1938. He was Midland, Tex., division geophysicist and geophysical supervisor for Continental's British Somaliland affiliate before transferring to the Venezuelan company in 1955.

Van Griethuysen

DEATHS

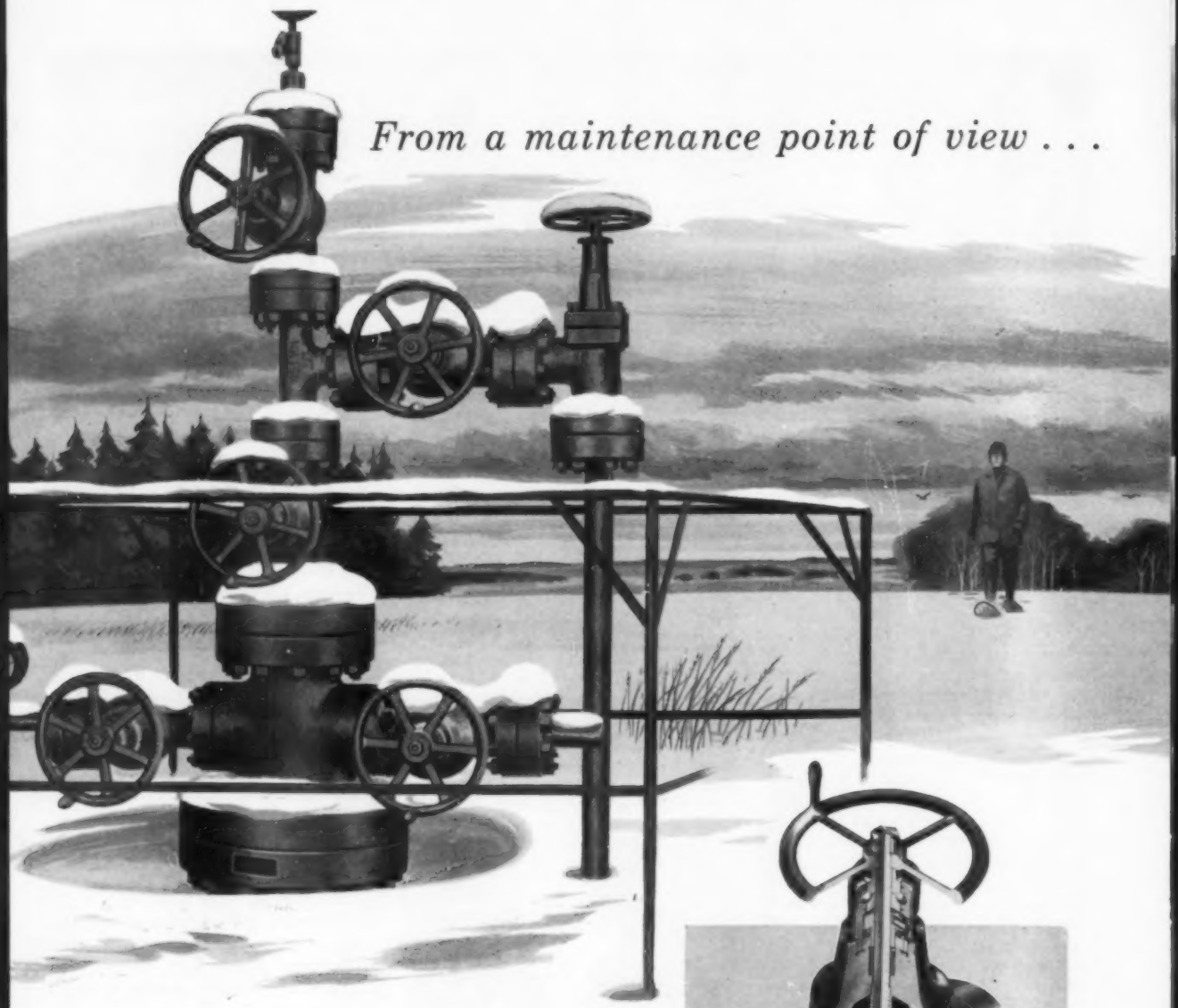
Thomas J. Sullivan, 64, Pittsburgh, senior vice president of Gulf Oil Corp., died May 28 in Pittsburgh after a heart attack. Sullivan had been with Gulf for 35 years. He was assistant general superintendent of Gulf's Texas refineries before transferring to Pittsburgh in 1939 as assistant general manager of manufacturing. He was named vice president in charge of manufacturing in 1949.

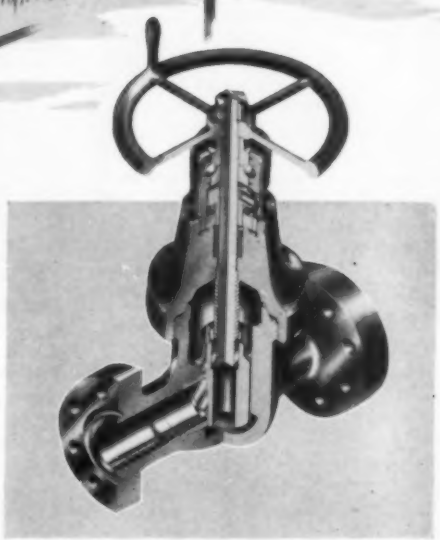
Walter R. Reitz, who retired last month as chairman of the board of Quaker State Oil Refining Corp., died May 25 in Oil City, Pa. Reitz was with Quaker State and its predecessors for 35 years, He had been executive vice president and president of the company before becoming chairman in 1955.

Edward L. McDowd, 63, chief scout for Shell Oil Co. for 20 years before his retirement in 1954, died May 21 in Los Angeles after a heart attack.

T. Blake Kennedy, 83, Cheyenne, Wyo., retired U. S. district judge who presided over the Teapot Dome oil scandal trials of the Harding administration, died recently.

From a maintenance point of view . . .





BIW non-lubricated gate valves

Whether your locations are this remote or not, you can reduce maintenance costs and increase your operating efficiency with BIW Valves. Because once they are in, you can forget them. You waste no man-hours lubricating them. The tight metal-to-metal seal and the simplified design of the valve have been proved in years of trouble-free service.

The BIW gate valve is truly easy to open or close under pressure. For instance, the 10,000 lb. test, 2½ in. valve requires only 25 foot-pounds of torque against a pressure of 5,000 psi. Plus, when you close it, you know that it will hold. More than 35,000 BIW Valves in the field are holding now, and will be working smoothly, effectively and with no fuss years from now.

ALCO specialists are available to consult with you. Write or call Petroleum Industry Equipment Division, Department BV-2, Bank of the Southwest Building, Houston 2, Texas.

ALCO

ALCO PRODUCTS, INC.

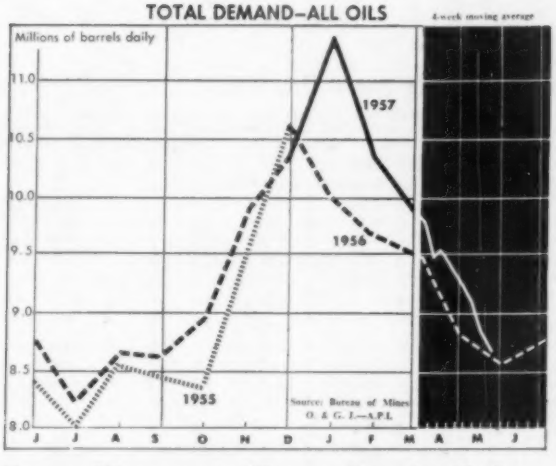
NEW YORK

Sales Offices in Principal Cities

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,429,900	DOWN	55,550	UP	359,210
Crude stocks	264,111,000	UP	2,235,000	DOWN	12,113,000
Completions	1,028	UP	44	DOWN	92
Refinery runs	7,910,000	DOWN	221,000	UP	113,000
Gasoline stocks	194,373,000	DOWN	2,010,000	UP	10,863,000
Kerosine stocks	23,935,000	UP	1,081,000	UP	3,236,000
Distillate stocks	91,532,000	UP	4,702,000	UP	19,505,000
Residual stocks	39,791,000	UP	365,000	UP	5,004,000
Four-product stocks	349,631,000	UP	4,138,000	UP	38,608,000
Total imports	1,423,700	UP	100,700	DOWN	102,800



Barge Movement Shows Supply Shifts; Group 3 Gasoline Prices Rise

SOME of the shortage of light and heavy fuels on the Gulf Coast during the winter months is reflected in barge movement of products from District 3 to District 2.

For the 6-month period ended April 30, shipments of kerosine and distillate fuels into District 2 from Texas, Louisiana, and Arkansas amounted to 7,130,000 bbl. This total represented a decrease of 1,737,000 bbl. from the year before.

The breakdown by shipping states also shows the effect of the Suez-created shortage. Barge shipments of middle distillates to District 2 from Louisiana dropped 2,055,000 bbl. from the corresponding period last year. Texas shipments were off 87,000 bbl., but liftings from Arkansas increased 405,000 bbl. This figure for Arkansas covered only barge movement up the river and not the distillate that was reported to have gone down the river for export.

River shipments of gasoline into District 2 from District 3 for the period from last November to April represented a gain of 2,333,000 bbl. over the year-earlier period. Again, all of the gain was due to shipments out of Arkansas. Upriver liftings from Texas and Louisiana represented a decrease of 1,032,000 bbl. from the corresponding period a year earlier. But, shipments out of Arkansas were up 3,365,000 bbl.

The Arkansas increase probably was split between shipments from Helena and from West Memphis. The gain out of West Memphis does not represent a net increase in the District 2 supply since the products originate in Oklahoma which is within the district.

Liftings of heavy fuel dropped from 2,129,000 bbl. a year ago to 1,336,000 bbl. for the more recent period. Most of this was contract material, shipped to meet definite obligations.

BARGE SHIPMENTS, DISTRICT 3 TO DISTRICT 2
November 1956 through April 1957
(Thousands of barrels)

	From Texas	From Louisiana	From Arkansas	Total
Gasoline	4,309	7,508	10,342	22,159
Kerosine	240	795	865	1,900
Light heating oil	341	260	2,953	3,554
Gas oil	207	999	470	1,676
Heavy fuel	635	701	.....	1,336
Lubricants	508	48	.....	556
Miscellaneous	221	199	.....	420
Total	6,461	10,510	14,630	31,601

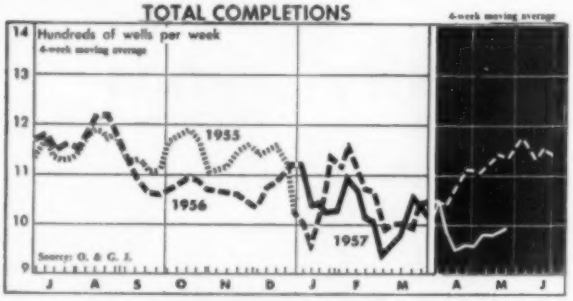
NOVEMBER 1955 THROUGH APRIL 1956

Gasoline	4,585	8,264	6,977	19,826
Kerosine	292	1,853	487	2,632
Light heating oil	201	1,258	2,847	4,306
Gas oil	382	998	549	1,929
Heavy fuel	1,395	734	.....	2,129
Lubricants	429	52	.....	481
Miscellaneous	70	215	.....	285
Total	7,354	13,374	10,860	31,588

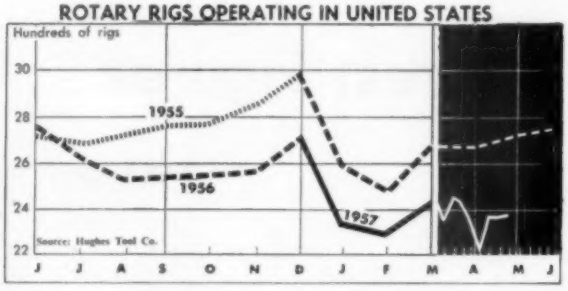
Group 3 gasoline prices move up . . . Group 3 gasoline prices edged up slightly during the past week. The average jobber's cost for material out of a pipeline terminal is about 12.00 cents a gallon for regular. The spread between regular and premium is either 1.75 cents or 2.75 cents, depending on whether the new premium is available at the terminal.

Despite the increase, the market cannot be classed as strong. A few weeks will be needed to test the new prices.

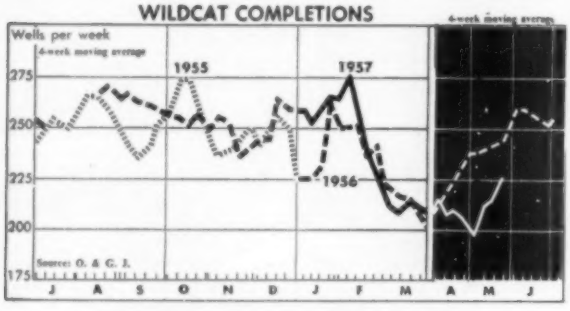
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	5-27-57	5-20-57	5-28-56
North Central and East	84	114	125
Southeast	41	45	29
Okla., Kans., Ark., Mo.	393	411	475
Louisiana	437	430	441
North and East Texas-Panhandle	365	347	436
Gulf and South Texas	211	207	251
West Texas-New Mexico	511	504	553
Rocky Mountain	248	229	251
Pacific Coast	94	92	112
Total United States	2,384	2,379	2,673
Canada	203	182	220

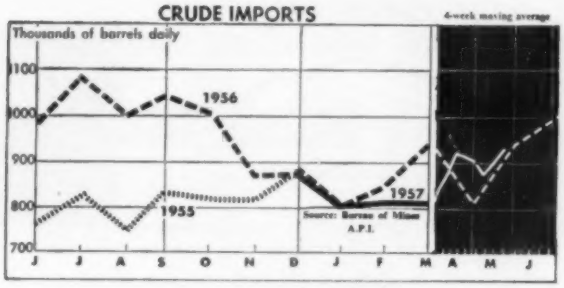
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MAY 25, 1957

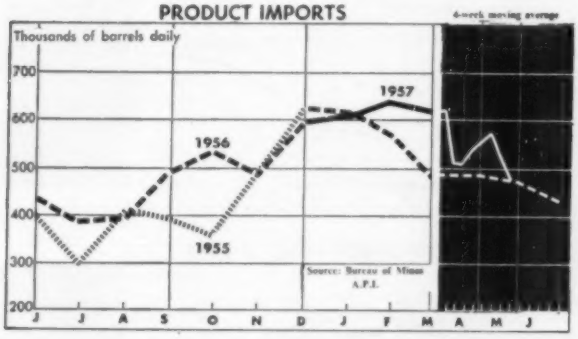
	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1957				
	Comp.	Oil	Gas	Dry	Footage	1957	1956	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	†2	1	0	1	21,709	48	40	0	0	0	1	1	0	0	1	18	19
Arkansas	11	9	0	2	34,990	375	311	1	0	0	2	3	8	0	2	50	60
California	58	45	0	13	243,343	865	866	3	0	0	10	13	27	0	2	183	212
Colorado	10	1	1	8	51,574	355	469	0	0	1	7	8	13	0	8	219	240
Illinois	86	32	1	53	193,277	956	1,421	1	0	0	18	19	12	0	1	219	232
Indiana	16	7	1	8	26,479	247	242	0	0	0	1	1	4	0	0	44	48
Kansas	67	24	3	40	253,968	1,646	2,026	2	0	1	17	20	46	0	11	259	316
Kentucky	37	17	3	17	37,224	546	657	0	0	0	1	1	12	0	4	89	105
Louisiana	48	22	6	20	364,330	1,478	1,537	0	0	0	4	4	32	9	37	185	263
North	11	5	1	5	33,689	497	591	0	0	0	1	1	4	0	3	48	55
South	21	11	4	6	177,382	696	756	0	0	0	1	1	19	8	28	116	171
Offshore	16	6	1	9	153,259	285	190	0	0	0	2	2	9	1	6	21	37
Michigan	8	2	0	6	20,529	159	180	1	0	0	3	4	6	0	0	61	67
Mississippi	7	3	0	4	59,848	147	179	2	0	0	4	6	10	0	0	60	70
Montana	11	5	0	6	46,590	134	132	1	0	0	4	5	4	0	0	46	50
Nebraska	22	8	0	14	130,236	320	383	1	0	0	12	13	17	0	0	162	179
New Mexico	40	19	13	8	162,812	785	704	0	0	0	3	3	27	1	6	75	109
Northwest	17	3	13	1	79,300	289	259	0	0	0	1	1	12	1	5	25	43
Southeast	23	16	0	7	83,512	496	445	0	0	0	2	2	15	0	1	50	66
New York	9	4	0	‡5	9,250	186	....	0	0	0	0	0	0	0	1	0	1
North Dakota	2	1	0	1	19,258	109	92	0	0	0	1	1	5	0	0	38	43
Ohio	17	6	7	§4	40,880	409	415	0	0	0	0	0	0	0	0	3	3
Oklahoma	81	41	9	¶31	323,660	2,565	3,529	1	0	2	12	15	40	9	8	238	295
Pennsylvania	0	0	0	0	0	337	*410	0	0	0	0	0	0	0	14	19	33
Texas	463	280	15	168	1,983,377	8,790	8,776	12	5	3	99	119	259	31	86	1,911	2,287
Southwest (1 & 4)	55	24	1	30	228,197	1,063	1,267	1	1	0	20	22	34	11	23	323	391
Gulf Coast (2 & 3)	56	25	6	25	371,713	1,012	1,099	0	4	2	11	17	18	16	41	275	350
East (5 & 6)	21	10	0	11	123,057	495	450	0	0	0	4	4	4	0	2	143	149
N. Central (7-B & 9)	179	106	2	71	524,704	3,202	3,157	9	0	0	45	54	142	0	10	826	978
West (7-C & 8)	128	106	1	27	645,800	2,480	2,308	2	0	0	18	20	57	0	8	317	382
Panhandle (10)	24	15	5	4	89,906	538	495	0	0	1	1	2	4	4	2	27	37
Utah	2	1	0	1	11,496	70	36	0	0	0	0	0	5	0	3	32	40
West Virginia	7	2	4	1	16,753	240	263	0	0	0	0	0	0	0	7	4	11
Wyoming	22	11	2	‖9	86,815	324	305	1	0	0	5	6	13	0	3	96	112
Miscellaneous (S. D.)	2	0	0	2	6,398	29	56	0	0	0	2	2	0	0	1	23	24
Total U. S.	**1,028**	541	65	422	4,144,796	21,120	23,029	26	5	7	206	**244**	540	50	195	4,034	4,819
Total previous week	984	535	81	368	4,112,305	....	....	18	4	12	189	223	514	45	188	3,828	4,575
Total May 26, 1956	1,120	563	104	453	4,385,680	....	....	33	0	11	212	256	619	62	161	4,174	5,016
Cumulative 1957	21,120	11,320	1,515	8,285	87,496,989	....	....	....	....	....	....	....	....	....	....	....	....
Western Canada	42	29	2	11	216,043	982	896	1	0	1	8	10	26	0	20	223	269

Service wells included: ‡5, §1, ¶3, ‖2. *Incl. N. Y. †Ala.

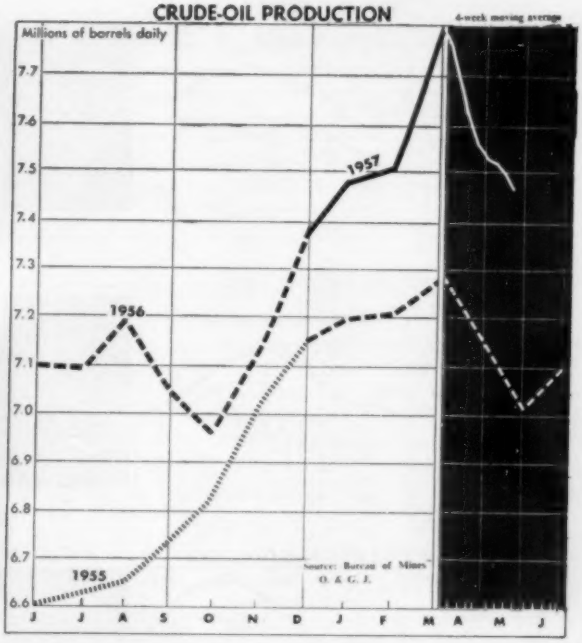
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION



DAILY AVERAGE PRODUCTION FOR WEEK

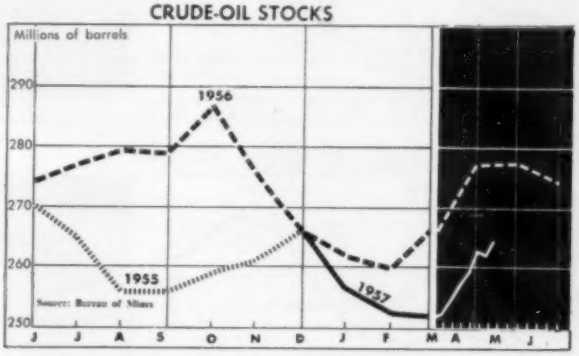
	May 25, 1957			May 18
	Crude oil	Lease condensate	Total	total
Alabama	12,000	.....	12,000	11,825
Arkansas	85,150	350	85,500	85,200
California	927,500	.....	927,500	928,300
Colorado	153,600	.....	153,600	157,500
Eastern	50,600	.....	50,600	49,900
Florida	1,250	.....	1,250	1,250
Illinois	223,300	.....	223,300	225,400
Indiana	31,700	.....	31,700	32,700
Kansas	†341,600	.....	†341,600	†360,500
Kentucky	47,100	.....	47,100	47,700
Louisiana	853,300	73,000	926,300	926,200
North	130,800	3,000	133,800	133,700
South	722,500	70,000	792,500	792,500
Michigan	28,100	.....	28,100	28,900
Mississippi	110,650	4,375	115,025	115,025
Montana	71,650	.....	71,650	71,800
Nebraska	54,125	.....	54,125	50,750
Nevada	100	.....	100	100
New Mexico	264,650	4,600	269,250	269,250
North Dakota	29,000	.....	29,000	29,400
Oklahoma	†607,200	.....	†607,200	†636,400
Texas	3,107,000	53,800	3,160,800	3,160,800
Dist. 1	57,000	450	57,450	57,450
Dist. 2	148,000	8,350	156,350	156,350
Dist. 3	440,000	26,300	466,300	466,300
Dist. 4	231,000	6,300	237,300	237,300
Dist. 5	40,000	400	40,400	40,400
Dist. 6	136,000	6,000	142,000	142,000
East Texas Field	205,000	.....	205,000	205,000
Dist. 7-B	167,000	75	167,075	167,075
Dist. 7-C	170,000	3,800	173,800	173,800
Dist. 8	1,185,000	1,100	1,186,100	1,186,100
Dist. 9	218,000	700	218,700	218,700
Dist. 10	110,000	325	110,325	110,325
Utah	11,100	.....	11,100	9,100
Wyoming	283,000	.....	283,000	287,350
Others	‡100	.....	‡100	‡100
Total U. S.	7,293,775	136,125	**7,429,900**	7,485,450
Change from prev. week, down			**55,550**	
Canada	†562,100	.....	†562,100	†560,600

Total U. S. production—January 1-May 25 ..... 1,101,208,575 bbl.

Same period last year (crule plus cond.) ..... *1,048,840,636 bbl.

*Includes 18,737,160 bbl. condensate. †Week ended previous Monday. ‡South Dakota.

CRUDE-OIL STOCKS



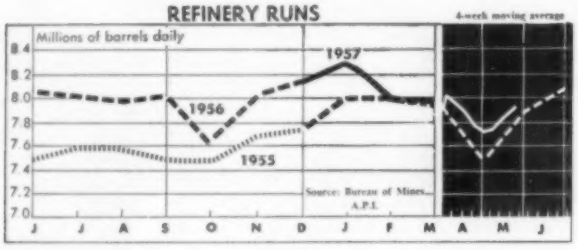
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

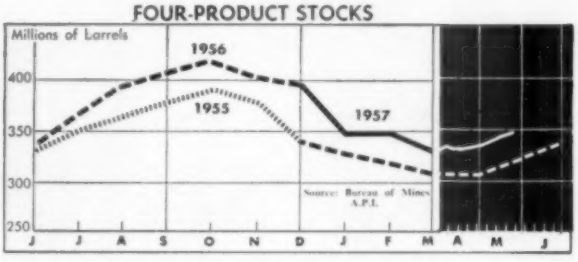
	5-18-57	5-11-57	5-19-56
Pennsylvania Grade	2,700	2,710	2,669
Other Appalachian	1,809	1,953	2,229
Illinois, Indiana, Michigan	9,658	9,524	10,609
Nebraska, North Dakota	1,803	1,702	2,410
Kansas	10,591	9,938	9,147
Oklahoma	22,467	22,854	27,200
Arkansas	2,752	2,728	3,039
Louisiana	18,366	18,187	16,729
North	2,875	2,998	2,542
South	15,491	15,189	14,187
Mississippi	2,617	2,620	2,936
New Mexico	7,756	7,315	7,541
Texas	121,816	119,775	126,743
East Texas proper	11,819	11,142	9,256
West Texas	57,681	57,035	62,150
Texas Gulf	23,241	22,120	22,883
Other Texas	29,075	29,478	32,454
Wyoming	16,936	16,267	17,240
Other Rocky Mountain	6,248	6,330	6,093
California	25,615	26,176	27,446
Foreign	†12,977	13,797	14,193
Total	264,111	261,876	276,224

*Bureau of Mines. †Includes 2,630,000 bbl. in California.

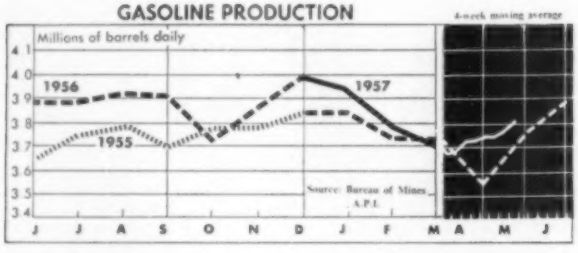
REFINERY RUNS



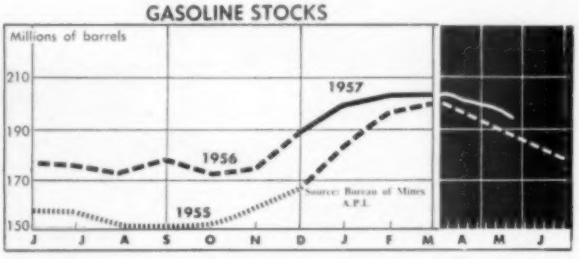
FOUR-PRODUCT STOCKS



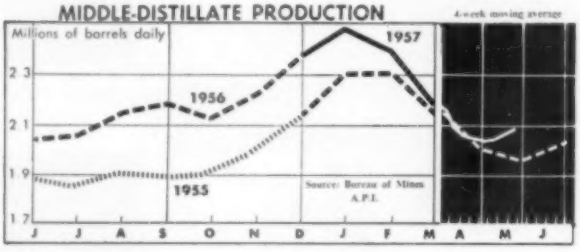
GASOLINE PRODUCTION



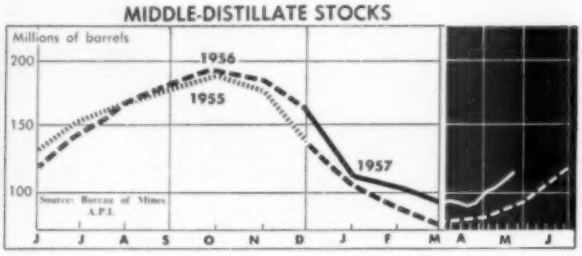
GASOLINE STOCKS



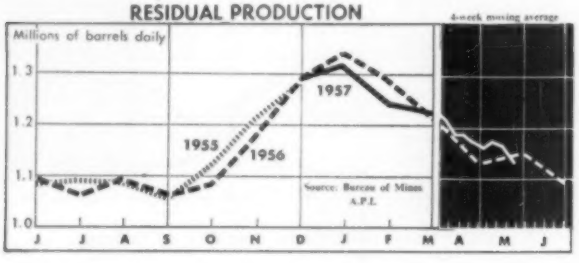
MIDDLE-DISTILLATE PRODUCTION



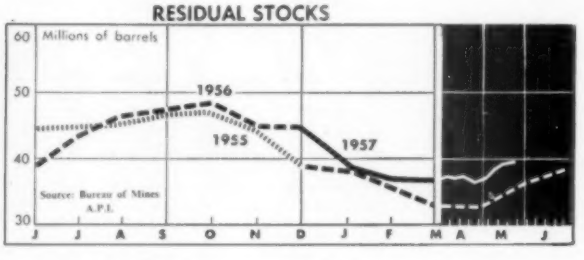
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, MAY 24, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, May 1956—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,157	481.4	10.8	302.9	199.3	42,300	10,067	30,658	10,177	1,043	417.0	27.6	239.6	196.5
Appalachian:														
District 1	93	37.0	4.6	21.3	4.9	4,811	523	1,941	459	93	35.5	3.7	22.4	4.0
District 2	80	46.0	3.1	15.1	10.4	2,645	420	681	342	106	49.7	4.0	17.2	15.0
Ind., Ill., Ky.	1,401	683.7	61.6	282.7	143.3	34,871	4,159	14,202	5,109	1,359	678.3	70.7	253.8	167.4
Minn., Wis., Dak.	104	48.7	6.6	30.9	10.3	6,414	558	3,939	395	79	36.7	5.0	22.4	5.8
Okla., Kans., Mo.	736	415.0	18.6	161.4	20.0	18,402	1,244	8,270	904	704	377.9	18.9	151.1	30.1
Inland Texas	262	182.0	4.6	53.4	21.7	7,712	340	1,900	1,749	280	199.0	8.4	52.6	24.0
Texas Gulf Coast	1,906	923.7	98.4	499.6	230.1	26,341	3,141	10,126	4,805	2,019	939.9	98.1	480.4	262.3
La. Gulf Coast	632	358.0	48.6	186.2	39.0	10,591	2,274	5,008	1,475	710	362.9	38.5	169.9	52.0
N. La. and Ark.	85	29.3	6.4	18.0	4.9	4,422	688	1,660	76	97	30.1	5.3	24.2	6.1
Rocky Mountain:														
New Mexico	28	14.0	0.6	5.1	3.6	414	6	91	66	22	11.6	0.4	4.1	3.2
Other Rocky Mtn.	234	120.3	2.1	54.4	32.8	7,470	231	2,516	1,133	270	121.5	3.8	63.4	32.7
California	1,192	532.6	2.3	167.9	363.1	27,980	284	10,540	13,101	1,114	496.0	7.8	165.5	349.6
May 24, 1957	7,910	3,871.7	268.3	1,798.9	1,083.4	194,373	23,935	91,532	39,791	7,896	3,756.1	292.2	1,666.6	1,148.7
May 17, 1957	8,131	3,865.3	267.9	1,857.6	1,114.0	196,383	22,854	86,830	39,426	.....	.....	.....	.....	.....
May 25, 1956	7,797	3,664.1	251.7	1,731.6	1,148.9	183,510	20,699	72,027	34,787	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
★ Regular (88 octane)	12.00-12.50
★ Premium (96-98 octane)	13.75-14.75
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.75-11.25
Regular (92 octane)	11.00-11.50
Premium (97 octane)	12.75-13.25
Premium (98 octane)	13.00-13.50
California (rack):	
Regular (86 octane)	13.1
Premium (93 octane)	15.3
Premium (96 octane)	16.2
Caribbean area (cargoes):	
Regular (87 octane)	10.875
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.0
Breckenridge:	
Grade 26-70	3.5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16-lb. Prices for grades below 16-lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	10.00-10.375
Diesel oil (58 d.i. and above)	9.625-9.875
Distillate No. 1	9.625-9.875
Distillate No. 2	9.00-9.375
Gulf Coast (cargoes):	
Kerosine 41-43	10.125-10.50
Distillate No. 2	9.625-10.00
New York Harbor (barges):	
Kerosine 41-43	11.75
Distillate No. 2	11.15
Diesel fuel, 48-52 d.i.	11.45
Caribbean area (cargoes):	
Distillate No. 2	9.75-10.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$2.25-2.35
Gulf Coast (cargoes):	
Bunker C fuel	$2.75-3.00
New York Harbor (barges):	
Bunker C fuel	$3.10
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.67				
15-15.9	2.71				$1.89
16-16.9	2.74				1.94
17-17.9	2.78				1.99
18-18.9	2.82				2.04
19-19.9	2.85				2.09
20-20.9	2.89	$2.75		$2.62	2.14
21-21.9	2.93	2.77		2.64	2.19
22-22.9	2.97	2.79		2.66	2.24
23-23.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95		2.82	2.63
31-31.9	3.38	2.97		2.84	2.67
32-32.9	3.44	2.99		2.86	2.71
33-33.9	3.50	3.01		2.88	2.75
34-34.9	3.56	3.03		2.90	2.79
35-35.9	3.61	3.05		2.92	2.83
36-36.9	3.65	3.07		2.94	2.87
37-37.9	3.68	3.09		2.96	2.89
38-38.9		3.11		2.98	2.91
39-39.9		3.13		3.00	2.93
40 and up		3.15		3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low Cold test Gulf Coast. ‡Sour.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, January 16, 1957.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.88
Middle District	4.70
Southwest Pennsylvania	4.41
West Virginia	4.23
Buckeye Grade	4.23
Zanesville Grade	3.27
Illinois Basin	3.15
Canada:	
Leduc-Woodbend	2.78
Redwater (Alta.)	2.67
Smiley (Sask.)	2.44
Pembina	2.65

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 40°-40.9°, Puerto La Cruz	3.37
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$1.97
★ Iranian, 34.0°-34.9°	1.91-2.04
★ Iranian, 34.0°-34.9°	1.86-1.99
★ Iraq, 36.0°-36.9°	1.87-2.00
★ Kuwait, 31.0°-31.9°	1.72-1.85
★ Qatar, 39.0°-39.9°, Umm Said	2.06-2.19
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.69
Iraq, 36.0°-36.9°, Tripoli, Banias	2.69
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°-38°	2.60

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

★ Gulf-U.S.N.H., dirty (USMC—30%)	$2.00
★ N.W.I.-U.S.N.H., dirty (USMC—50%)	1.35
★ N.W.I.-U.K., dirty (USMC—50%)	3.28
★ Sidon-U.S.N.H., dirty (USMC—45%)	4.29
P.G.-California, dirty (USMC—40%)	9.78

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8—Hi-vol pumps, 10 x 7 x 18, 10 x 6 x 13, 6 x 4 x 12, 6 x 3 x 8.

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1—14' x 21' Clay Tower, 125#
1—8' x 73' Tower, 20 Trays, 25#
1—18" x 32' Tower, 15 Trays, 160#
2—8½' x 25' Tanks 50#
5—Packed Towers 14" x 40', 18" x 23', 160# Wyatt 1950.
1—Poly Reactor, 550#, 24" x 28'.

HOT-OIL PUMPS

3 Pacific ITB, 400 gpm—2,000' hd, 735 gpm—3,100' hd.
5 Pacific SVTB, 612 gpm—600' hd, 324 gpm—480' hd, 308 gpm—516' hd, 193 gpm—389' hd.
1 Pacific HVTB (unused) 1270 GPM—408' Hd.
BJ hot oil pump 3 x 9, 13 st, 325 gpm, 4600' hd.

HEAT EXCHANGERS

4—Kellogg Adm. Flng. Hd. 2200, 1300 Sq. Ft., 315#
4—Kellogg Stel Flng. Head. 800, 650, 500 Sq. Ft.
18—GR Fin Tubes, 73 Sq. Ft.
6—Brown fintube exchangers, 300# 140 Sq. Ft. 4-6 chrome.
5—Steel 1,000, 900, 800, 600, 500 Sq. Ft.
6—Adm. 785, 742, 425 Sq. Ft.
30—304 SS shell & tube condensers 100-1000 Sq. Ft.

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1 Worth LTC-6 800 hp.
3 Penn Comps 100 CFM 500 lbs.
385 CFM 160 lbs.

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6—Bird Centrifugals 32 x 50, 24 x 38, 18 x 28.
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4—Rotary Vac. Filters, 10 x 12, 8 x 10, 5 x 8
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LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Denver, Colorado. Notice is hereby given that 97.87 acres of land in three parcels within the known geologic structure of Rangely Field, in Rio Blanco County, Colorado, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre, at 2 p.m., M.S.T., July 25, 1957, when bids will be opened. Details of the lease offering, how and where to submit bids, and forms, may be obtained from the Bureau's Land Office, P. O. Box 1018, Denver, Colorado. George H. Woodhall, Manager.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that 647.20 acres of land within the known geologic structure of the Caddo-Pine Island, Naborton, Greenwood-Waskom and Rodessa Fields in Caddo and De Soto Parishes, Louisiana, will be offered for oil and gas leasing through competive bidding to the qualified bidder of the highest cash amount per acre at 1:00 P.M., EST, June 19, 1957, when bids will be opened. Details of the lease offering, description of the lands, how and where to submit bids, and bid forms may be obtained from the Manager, Eastern States Land Office, Bureau of Land Management, Washington 25, D. C., H. K. Scholl, Manager.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Denver, Colorado. Notice is hereby given that 80 acres of land in one parcel within the known geologic structure of Happy Hollow Field, in Delta County, Colorado, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre, at 2 p.m., M.S.T., July 26, 1957, when bids will be opened. Details of the lease offering, how and where to submit bids, and forms, may be obtained from the Bureau's Land Office, P. O. Box 1018, Denver, Colorado. George H. Woodhall, Manager.

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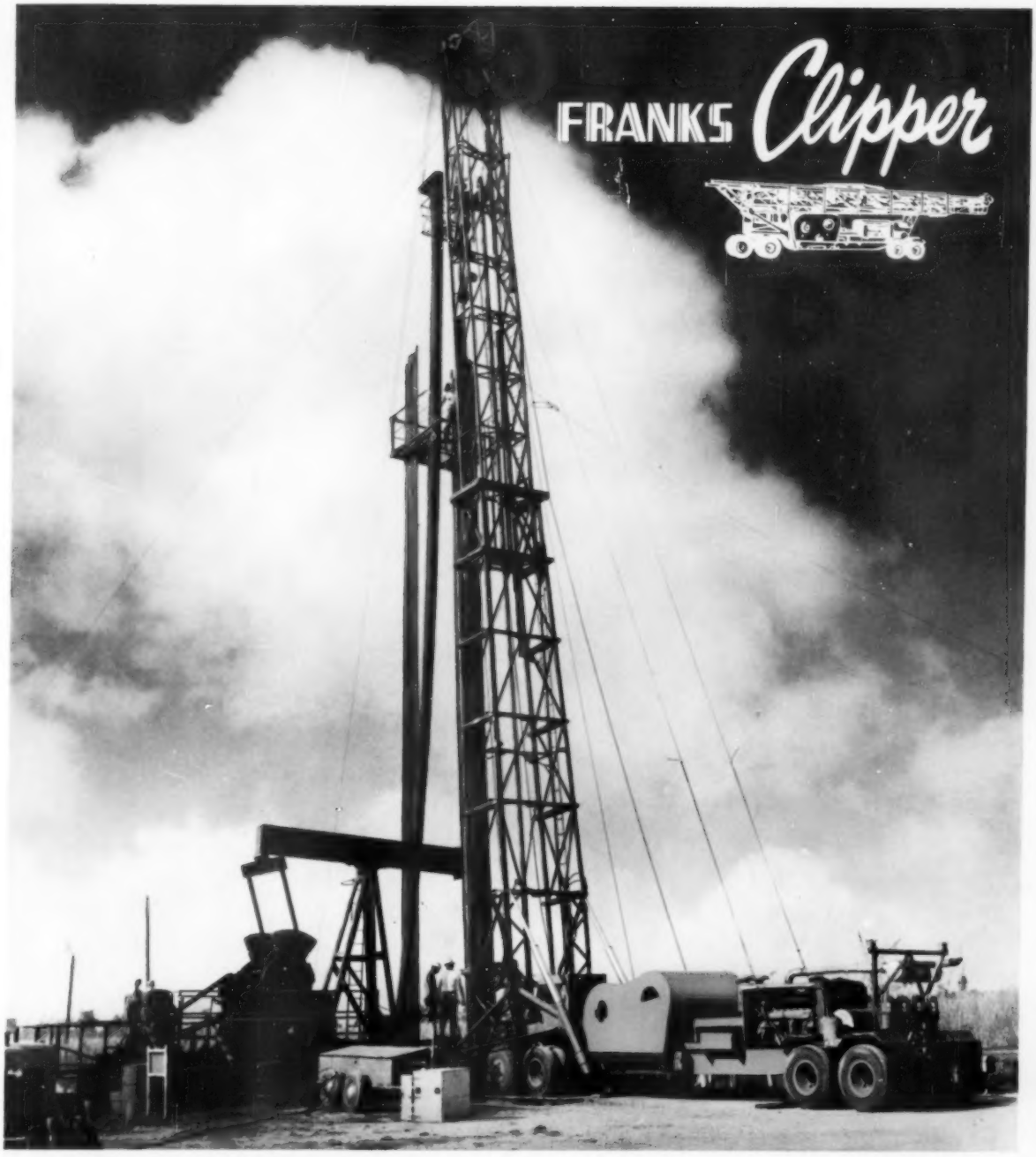

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